REVISTA ESPAÑOLA DE COMUNICACIÓN EN SALUD
2026, v. 17, n. 1, 42-59
https://doi.org/10.20318/recs.2026.9693

Originales

Análisis de temas durante crisis sanitarias: Cobertura mediática de las vacunas COVID-19 en México

Topic Analysis During Public Health Crises: Media Coverage of COVID-19 Vaccines in Mexico

Erick Cruz-Mendoza[a], Oscar Fontanelli Espinosa[b]

[a] Universidad Autónoma de Querétaro, México
[b] Facultad Latinoamericana de Ciencias Sociales, México

Resumen

Introducción: Este estudio examina la evolución de los marcos temáticos en la cobertura mediática mexicana sobre las vacunas contra la COVID-19 entre 2020 y 2021, dado que las narrativas de los medios configuran la percepción pública y la confianza institucional durante crisis sanitarias. **Objetivos:** La investigación busca identificar y analizar los temas dominantes en la cobertura de vacunas contra la COVID-19 en México y seguir su evolución temporal. **Metodología:** Se analizó un corpus de 43.358 artículos de periódicos nacionales relevantes en México. Utilizando Latent Dirichlet Allocation (LDA), una técnica de modelado de temas del Procesamiento de Lenguaje Natural, se categorizó trimestralmente el contenido de las noticias para mapear la evolución temática a lo largo del tiempo. **Resultados:** Se identificaron cinco temas principales: crisis sanitaria y económica global, relaciones internacionales, gestión de la pandemia a nivel estatal, respuestas institucionales a grupos sociales y política nacional de salud pública. Los hallazgos muestran una progresión clara desde marcos centrados en la crisis global hacia discusiones de política más localizadas. **Conclusión:** El estudio destaca cómo la cobertura mediática evoluciona en respuesta a cambios sociales y epidemiológicos, ofreciendo información valiosa para el diseño de estrategias de comunicación sanitaria oportunas y culturalmente apropiadas.

Palabras clave: Pandemias; COVID-19; Noticias; Procesamiento de Lenguaje Natural

Abstract

Introduction: This study examines the evolution of thematic frameworks in Mexican media coverage of COVID-19 vaccines between 2020 and 2021, given that media narratives shape public perception and institutional trust during health crises. **Objectives:** The research aims to identify and analyze the dominant themes in COVID-19 vaccine coverage in Mexico and track their temporal evolution. **Methodology:** A corpus of 43.358 articles from major national newspapers in Mexico was analyzed. Using Latent Dirichlet Allocation (LDA), a topic modeling technique from Natural Language Processing, news content was categorized quarterly to map thematic developments over time. **Results:** Five key topics were identified: global health and economic crisis, international relations, pandemic management at the state level, institutional responses to social groups, and national public health policy. Findings show a clear progression from global crisis frames to more localized policy discussions. **Conclusion:** The study highlights how media coverage evolves in response to social and epidemiological changes, providing insights for designing timely, culturally appropriate health communication strategies.

Keywords: Pandemics; COVID-19; News; Natural Language Processing

CONTACTO: Erick Cruz-Mendoza erick.cruz@uaq.edu.mx

Fecha de envío:03/10/2025
Fecha de aceptación: 30/04/2026

Introduction

The COVID-19 pandemic represented an unprecedented public health challenge and a critical test for information and communication systems (Yakunin et al., 2021; Rovetta & Castaldo, 2021; Mach et al., 2021). In this context, the media played a key role in shaping narratives around the strategies implemented by governments and health systems to contain the spread of the virus and reduce mortality (Anwar et al., 2020), with vaccination being one of the fundamental pillars (Su et al., 2021; Pennisi et al., 2024).

The arrival and distribution of vaccines quickly became a central topic in public discourse (Alhassan et al., 2021; Mahato et al., 2023). Amid uncertainty and polarization, the media reported on scientific and logistical advances and framed health-related information through various narrative approaches (Viswanath et al., 2021; Montagni et al., 2021). In particular, the media's framing of vaccination issues became crucial in shaping public attitudes toward the pandemic response. Consequently, the research questions addressed in this study are: What were the predominant themes in the news about COVID-19 vaccines in Mexico during the pandemic? How did these themes evolve over time? And how can the results of the LDA thematic modeling be linked to the epidemiological context?

This study is grounded in communication theory, with a particular emphasis on framing analysis within the field of health communication. Its main objective is to identify the predominant thematic frames and trace their evolution in media coverage of COVID-19 vaccines in Mexico during the pandemic, specifically between 2020 and 2021. To achieve this, it employs Latent Dirichlet Allocation (LDA), an advanced machine learning technique for topic modeling that enables the analysis of large-scale textual data. By applying LDA to a corpus of 43.358 news articles collected during this period, the study offers a robust empirical examination of media discourse and its alignment with evidence-based communication strategies.

Mexico constitutes a privileged case for analyzing media coverage of COVID-19 vaccines in Latin America. As one of the first countries to acquire and distribute vaccines, its centralized communication strategy generated a complex public narrative shaped by political polarization, misinformation, and the diversity of available vaccines. Its heterogeneous media ecosystem enables an examination of how different actors framed vaccination efforts in a context of heightened uncertainty.

While the literature has examined the coverage of health crises through concepts such as the media-epidemiological cycles proposed by Waisbord (2010), which describe how health-related issues gain and lose visibility in journalistic and digital agendas, the present study departs from this approach by prioritizing the analysis of the thematic configuration and framing of the pandemic. In this regard, although the media played a central role during the health crisis, vaccine-related frames in the Ibero-American region remain relatively understudied. Nevertheless, recent years have witnessed the emergence and gradual consolidation of a line of research aimed at understanding pandemic communication from a media framing perspective.

Several contributions have begun to address this gap, including studies conducted in Mexico (Rodelo, 2021; Cruz-Mendoza, 2026), Argentina (Zunino & Arcangeletti, 2020; Zunino, 2022; Demonte et al., 2024; Cruz-Mendoza et al., 2025; De Gennaro, 2025), as well as comparative analyses across Latin American countries such as Mexico, Brazil, and Peru (Angulo-Giraldo & Requena, 2025; Morejón-Llamas, 2023).

Additional research has also been conducted in Spain (Catalán-Matamoros et al., 2024; Catalán-Matamoros & Langbecker, 2023). Taken together, these studies point to the consolidation of an emerging field in which vaccines occupy a central role as objects of symbolic dispute, meaning-making, and technoscientific mediation (Estrella-Pacheco, 2023).

In this context, the present study advances this line of inquiry through a large-scale computational analysis of a Spanish-language corpus, highlighting the relevance of producing rigorous communication research.

By identifying five key thematic framings—including one centered on President Andrés Manuel López Obrador (AMLO)—the study expands the empirical scope of health communication research and underscores the need to incorporate peripheral perspectives into global debates on science, politics, and public discourse in times of crisis.

To contextualize this study, it is sufficient to note that COVID-19 emerged in late 2019 in China and rapidly spread worldwide, leading the World Health Organization to declare a Public Health Emergency of International Concern in January 2020 and a pandemic in March of the same year (WHO, 2020a). In this context, international initiatives were promoted to accelerate vaccine development and ensure equitable access, such as C-TAP and COVAX, while by the end of 2020 multiple vaccine candidates were already in different phases of clinical trials and mass vaccination had begun (WHO, 2020b).

In Mexico, the first confirmed COVID-19 case was reported on February 27, 2020, and, following the increase in infections, social distancing measures and the suspension of non-essential activities were implemented across different epidemiological phases (Escudero et al., 2020; Suárez et al., 2020). Subsequently, the epidemiological traffic light system was adopted as a mechanism to regulate the reopening of social and economic activities (INAI, 2020).

The pandemic had significant effects in Latin America, deepening the regional economic crisis (CEPAL, 2023) and revealing structural inequalities, as well as limitations in Mexico's healthcare infrastructure (Cortez-Gómez et al., 2020; Olivera-Martínez & García-Andrés, 2021; Torres-Toledano et al., 2023). In this context, social support programs were implemented to mitigate its economic impacts (Lomelí-Vanegas, 2020; Salas et al., 2020; Nájera & Huffman, 2021; García et al., 2022).

Regarding the health response, Mexico participated in international vaccine access mechanisms and received doses through initiatives such as COVAX (PAHO, 2020). The national vaccination campaign began in December 2020, prioritizing healthcare workers and vulnerable groups (Secretaría de Salud, 2021), and was supported by agreements to acquire vaccines from different developers, as well as by efforts to develop domestic capabilities, such as the "Patria" vaccine (COFEPRIS, 2022; CONAHCYT, 2021).

Framing and vaccines

Vaccines have been examined from multiple communication perspectives, including the relationship between media consumption and vaccination attitudes (Holton et al., 2012), the influence of anti-vaccine websites (Moran et al., 2016), social media polarization (Yuan et al., 2019), and trust in public health campaigns (Quinn et al., 2013). Within this framework, framing theory (Entman, 1993) is particularly relevant for understanding how the media select and emphasize specific aspects of reality, shaping public perceptions of vaccines and influencing interpretations of risk, benefit, and responsibility.

Framing analysis, grounded in interpretive sociology and extensively applied in media research, distinguishes between generic frames, which are broadly applicable, and thematic frames, which pertain to specific events and allow for more nuanced analyses (Entman, 1993). Thematic frames are key to structuring media narratives by defining problems, identifying causes, suggesting solutions, and articulating moral evaluations (Kohring & Matthes, 2002). These frames also reflect the influence of cultural and political contexts on media discourse (Günther et al., 2020), though persistent challenges include conceptual ambiguity and the overlap with other communication strategies (Kohring & Matthes, 2002).

Media narratives do not only inform but also shape public perception and institutional trust, which are critical elements for the success of vaccination campaigns during a health crisis

Penţa & Băban (2017), through a bibliometric review of publications from 2011 to 2016, confirmed that framing, particularly gain- versus loss-framing, affects parental intentions to vaccinate, consistent with prior findings (Abhyankar et al., 2007; Ferguson & Gallagher, 2010). Their work highlighted how message effects depend on perceived efficacy and individual risk assessments.

In the context of the COVID-19 pandemic, researchers analyzed media framing of the health crisis (Milutinović, 2021; Bhatti et al., 2022), including critiques of uncritical reporting on government actions (Solvoll & Høiby, 2023). Common methodologies included content analysis and topic modeling (Hung & Chang, 2023), although some scholars warned that automated methods often lack interpretive depth (Schwarz et al., 2023).

Key framing strategies during the pandemic included themes of hope, fear, and responsibility. Vaccines were often portrayed as the ultimate solution (Mutua & Oloo, 2020), while fear-based messaging emphasized the risks of non-vaccination (Afrin et al., 2022), producing both motivation and mistrust. Responsibility framing promoted vaccination as a civic duty (Okorie, 2022), though it also raised tensions concerning individual autonomy.

Many studies examined the intersection of media discourse, political agendas, and pharmaceutical interests, revealing how scientific narratives were at times manipulated for political or commercial purposes (Bharti & Sismondo, 2022). In the United States, Dickinson et al. (2024) demonstrated how partisan media, particularly right-wing outlets like Fox News, framed hydroxychloroquine optimistically, while left-leaning sources adopted a more skeptical stance. This dichotomy contributed to political polarization and the spread of misinformation, with tangible consequences for public health.

Kim et al. (2017) define framing as the way identical content can be presented differently across modalities (e.g., text or video) while emphasizing benefits or risks. In health contexts, promotion framing highlights the positive outcomes of action, whereas prevention framing emphasizes the safety of avoidance. Audience responses depend on both the medium and the specific frame employed.

Health communication

Beyond framing processes, these dynamics underscore the importance of accessible and accurate health communication. Scholars have long argued that individuals must be empowered to make informed health decisions (Neuhauser & Kreps, 2003; Freimuth & Quinn, 2004; Glik, 2007; Ishikawa & Kiuchi, 2010; Rudd et al., 2007; Aghazadeh & Aldoory, 2023; Bermeo et al., 2024). The proliferation of digital media has improved access to health information but also emphasized the need to enhance health literacy (HL), as insufficient comprehension can hinder effective decision-making.

Health literacy encompasses both cognitive and social skills that enable individuals to access, understand, and apply information to improve personal and community health (Ishikawa & Kiuchi, 2010). It is typically structured into three levels, basic, communicative/interactive, and critical, which support active participation in health-related decision-making. Improving HL is therefore critical for health promotion and disease prevention, requiring communication that is both clear and empowering (Sprengholz et al. 2023).

In the context of the pandemic, the proliferation of information—and misinformation—across traditional and digital media highlighted the importance of improving these competencies, as well as understanding how messages are constructed and disseminated. Although automated methods such as topic modeling have been widely used to analyze large-scale data (Milutinović, 2021; Hung & Chang, 2023), scholars have also pointed out the need to complement these approaches with critical interpretation (Schwarz et al., 2023). This is a gap we aim to address in this study.

Media coverage of COVID-19 vaccines in Latin America, particularly in Spanish, remains insufficiently explored. In Argentina, several studies have begun to examine how media discourse was constructed. Cuberli & Albardonedo (2020) show that Infobae's journalistic narrative prioritized novelty and controversy surrounding the vaccine. Zunino (2022) identifies different phases in the coverage of major Argentine newspapers (Infobae, Clarín, and La Nación), ranging from scientific concerns to geopolitical disputes and access issues. Likewise, Demonte et al. (2024) characterize public discourse in Argentina between 2020 and 2021, noting that the government succeeded in consolidating a narrative that positions vaccination as central to public health, although critical perspectives on the vaccination campaign remained limited.

In the same vein, Cruz-Mendoza et al. (2025) identify six key themes to understand the relationship between vaccines and the pandemic based on news analysis. Complementarily, De Gennaro (2025), through an analysis of 1,197 headlines, identifies three predominant dimensions: social trust in vaccines—including effectiveness, validation processes, anti-vaccine movements, and risk perception; vaccines—focusing on local production and specific cases such as Sputnik and Pfizer; and politics and the pharmaceutical industry—related to vaccine development, commercial interests, and vaccination campaigns.

In Mexico, Rodelo (2021) finds that COVID-19 coverage was characterized by a predominance of responsibility attribution, human interest, and political information frames, while scientific information and content aimed at self-efficacy remained marginal. In comparative studies across Latin America, Angulo-Giraldo & Requena (2025) identify four dominant discourses in media coverage from Mexico, Peru, and Brazil: vaccination as good news, as a controversy to be resolved, as an imperative, and within an international context.

In Spain, Catalán-Matamoros & Langbecker (2023), as well as Catalán-Matamoros et al. (2024), have advanced the understanding of the pandemic through analyses of media discourse and public perceptions of vaccines. Taken together, these studies point to an emerging, yet still limited, body of research focused on critically examining media communication about vaccines in the Ibero-American context.

In summary, framing studies conducted during the COVID-19 pandemic have significantly deepened our understanding of how the media shaped public perception and influenced political responses. While important theoretical and methodological advances have been made, persistent challenges, such as the limited incorporation of critical perspectives and the growing polarization of media narratives, highlight the ongoing need for research into the effects of media framing in global health crises. Within this framework, the present study adopts thematic frames as an analytical tool and

proposes their construction through an inductive, data-driven approach aimed at identifying how information is organized into latent topics.

Although the present study does not directly assess behavioral responses, analyzing the frames used in media coverage of COVID-19 vaccines is essential for understanding how narratives were constructed and how they may have influenced public trust, risk perception, and vaccine acceptance.

Methods

Design

This study adopts a non-experimental, descriptive-analytical design with a quantitative approach, aimed at identifying and characterizing the predominant thematic frames in Mexican media coverage of COVID-19 vaccines between 2020 and 2021. The object of study is media coverage of COVID-19 vaccination in Mexico, operationalized through a large-scale corpus of news articles. Methodologically, the study combines computational text analysis and quantitative content analysis within a data-driven framework. Specifically, topic modeling through the LDA algorithm is employed to inductively detect latent thematic structures in the corpus, while content analysis is used to support the interpretation and labeling of the identified themes. This integrative strategy allows for both the systematic extraction of patterns from large textual data and their analytical contextualization within media framing research.

Instrument

A corpus of 43.358 news articles in Spanish was obtained through the EMIS provider and distributed across eight quarters. Articles were selected using keywords including “vacuna COVID 19,” “vacuna(s),” “vacunas,” “vacunación,” “vacunado(s),” “vacunada(s),” “vacunarse,” “vacunaron,” and “vacunar,” ensuring that at least one of these terms appeared in the full text. Sources included national and local newspapers such as Excélsior, Milenio, El Heraldo, El Economista, El Sol, El Universal, Diario Xalapa, Diario de Yucatán, Diario de Juárez, Diario de Querétaro, Diario de Chihuahua, Diario de Tampico, Reforma, and Unión Morelos.

Procedure

The 43.358 news articles were cleaned and curated through processes such as tokenization and stopword removal, resulting in a curated dataset. The news was then divided by quarters, and the LDA algorithm was applied to each subset.

LDA is a widely used technique in Natural Language Processing to extract and model topics in textual corpora (Ejaz et al., 2023; Blei et al., 2003). LDA associates news articles with latent topics based on word distributions, modeling the parameters gamma (γ) for topic distribution within documents and beta (β) for word distribution within topics. Number of topics (k) is selected via a coherence metric, which measures overall semantic consistency within and across topics. The model was tested with 3 to 10 topics, and the optimal five-topic model (k=5) was selected based on a coherence score of 0.79 and its alignment with observed data trends.

Statistical Analysis

The interpretation of thematic units involved identifying the most frequent words per topic, tracking quarterly keyword trends, and conducting a content analysis of a randomly selected sample of 1.017 news articles (99% confidence level, 4% margin of error). LDA estimates document lengths using a Poisson distribution and assigns topics and words according to Dirichlet priors (Ejaz, et al., 2023; Li et al., 2019; Da et al., 2024). The analysis is supported by prior applications of LDA in health communication research, including literature reviews in clinical psychology and cancer (Hagg et al., 2022;

Tran et al., 2019), social media analyses on cancer, COVID-19, and natural disasters (Ramamoorthy & Mappillairaju, 2023; Xue et al., 2020; Zhou et al., 2023), and the study of patient narratives in medical contexts (Li et al., 2019; Da et al., 2024). Themes were then labelled based on quantitative word frequency and content analysis results to ensure representativeness and coherence.

Results

To analyze the evolution of media narratives about COVID-19 vaccines in Mexico, we constructed multiple LDA models by varying the number of topics from 3 to 10. After evaluating coherence metrics and contextual relevance, we selected the model with k=5 as the optimal configuration, obtaining a balance between thematic variation and internal consistency. This model effectively captures the dynamics of news production and their alignment with key events each quarter. While models with more topics (k=6 to k=10) offered greater specificity, they also risked over-segmentation. The five-topic model provided meaningful thematic distinctions without losing analytical clarity, revealing the main social, scientific, and health concerns throughout the analyzed period. Figure 1 illustrates the distribution and evolution of topics across different models, highlighting how thematic differentiation becomes more pronounced as the number of topics increases.

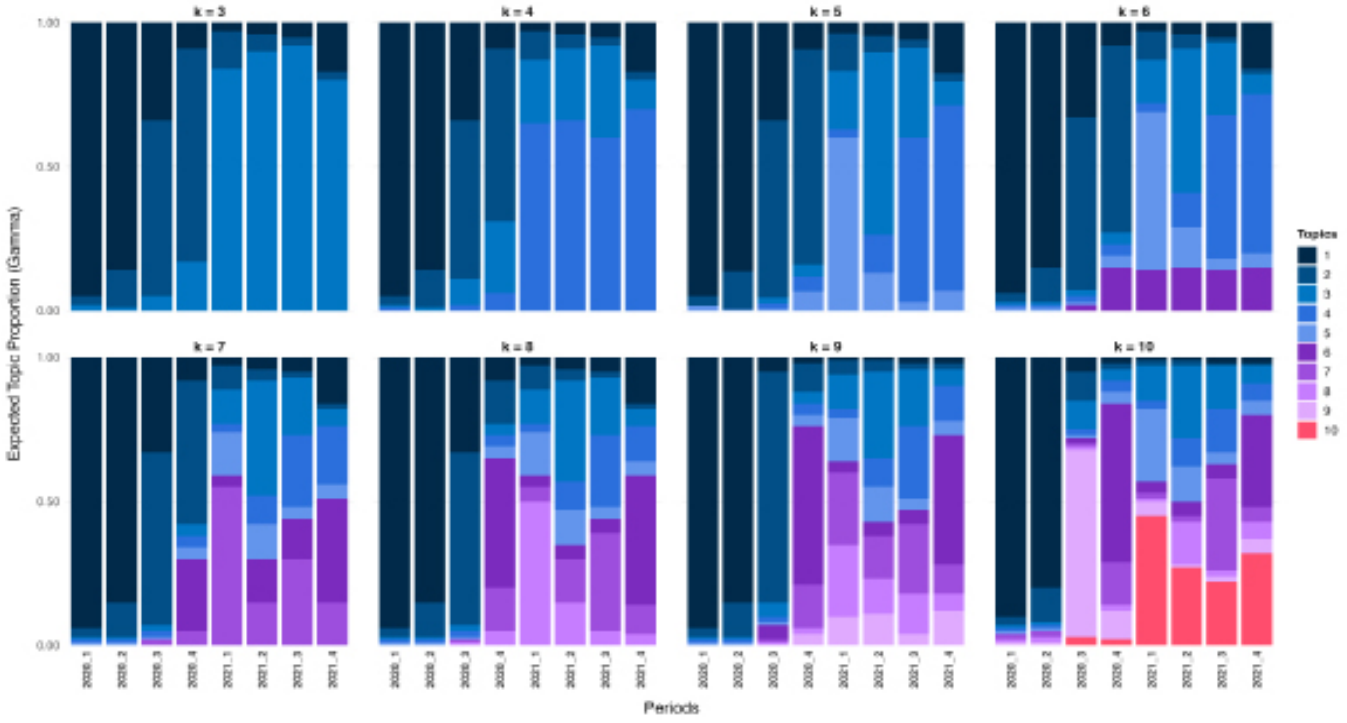

Figure 1. Distribution of topics in COVID-19 vaccine news in Mexico (2020-2021)
Source: Authors' elaboration

Table 1 illustrates the most relevant or representative words of each of the topics identified in the model. By observing these words, more precise associations can be made between each topic and the specific aspects of social and health reality that the topics reflect. This process of labeling the topics is essential for interpreting the LDA model, as it provides context and facilitates the linking of the topics with the underlying discourses and narratives in the news about COVID-19.

Table 1. Topic Labeling (k=5)

Topic	Words (beta)	Labeling
1	Europe (.00559), WHO (.00351), scientists (.00303), Latin America (.00265), economy (.00213), Asia (.00204), crisis (.00176), medications (.00175), work (.00162), research (.00162)	Global health and economic crisis
2	Hugo López Gatell (.00391), Pfizer (.00305), Marcelo Ebrard (.00203), patients (.00200), Donald Trump (.00198), companies (.00184), security (.00180), influenza (.00170), recovery (.00142), politics (.00142), results (.00141)	International relations
3	States of Mexico (.0298), classes (.00370), return (.00252), day (.00245), teachers (.00217), traffic light (.00217), women (.00187), governor (.00184), schools (.00178), in-person (.00173)	Management of the pandemic in the states
4	Children (.00928), youth (.00330), authorities (.00310), risk (.00257), life (.00170), omicron (.00153), family (.00143), parents (.00139)	Responses to social groups
5	AMLO (.0153), older adults (.00999), medical staff (.00952), government (.00626), adults (.00626), workers (.00238), Sputnik (.00189), AstraZeneca (.00164), Joe Biden (.00161).	Public health policy

Note: The words were translated from Spanish to English. **Source**: Author's elaboration

A description of each identified topic is presented below, which justifies the assignment of corresponding labels based on the most representative words associated with each.

Topic 1: Global health and economic crisis: This topic is clearly linked to the global health and economic crisis caused by the COVID-19 pandemic. Words associated with this topic include "Europe", "WHO", "scientists", "Latin America", "economy", "crisis" and "medicines" reflecting concerns about the global effects of the pandemic in terms of both health and the global economy. The terms "research" and "work" reinforce attention to scientific responses and the labor challenges amid the health crisis.

T*opic 2: International relations*: This topic relates to international interactions surrounding the pandemic, particularly decisions and key figures in vaccine distribution and health policies. Keywords like "Hugo López Gatell", "Pfizer", "Marcelo Ebrard", "Donald Trump" and "companies" suggest the importance of diplomacy, international agreements, and access to vaccines in a global crisis. Concepts like "security" and "recovery," pointing to the relationships between governments and their efforts to control the spread of the virus and protect their citizens, were also mentioned.

Topic 3: Pandemic management in states: This topic focuses on regional and local responses to managing the pandemic within Mexico. Associated words like "States of Mexico", "classes", "return", "teachers" and "schools" indicate the relevance of education and measures taken to resume in-person classes. Terms such as "traffic light", "shift" and "governor" refer to the control strategies and health management implemented in various Mexican states based on the local epidemiological context.

T*opic 4: Responses to social groups*: This topic addresses different social and political responses to the pandemic, specifically those related to the most vulnerable groups, such as children, youth, and families. Words associated with it, such as "children", "youth", "authorities", "risk" and "Omicron" show concern for protecting these groups

from the virus and implementing public policies for their protection. Mentions of "family" and "parents" reflect the importance of family decisions in the context of health measures.

Topic 5: Public health policy: This topic focuses on political decisions and government strategies implemented in Mexico in response to the pandemic. Key words like "AMLO" (President of Mexico), "older adults", "medical staff", "government" and "Sputnik" indicate that the topic is related to public health policies, especially concerning vaccination and the protection of vulnerable groups such as older adults and healthcare workers. Mentions of "AstraZeneca" and "Joe Biden" also suggest the international dimension of health policies and agreements around vaccines.

Each of these labels consistently reflects the identified topics based on the associated words, helping to understand the main narratives present in news about COVID-19 vaccines in Mexico during the pandemic. To corroborate the topics, news from each period were reviewed (this step was explained in the methodological design).

Table 2 illustrates the thematic distribution (γ values), representing the proportion of each topic within a document, for each quarter and the five topics identified in the k=5 model. These values reflect the strength of the relationship between each topic and the set of news articles for each period. Although each quarter includes news that may address multiple topics, the Gamma values indicate the proportion of the total content most strongly associated with each specific topic, allowing the identification of which predominate in each analyzed time period.

Table 2. Gamma values of the LDA model k=5

Period	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
2020_1 (508 news)	.95	.032	.001	.001	.016
2020_2 (2.005 news)	.863	.133	.001	0	.003
2020_3 (3.599 news)	.34	.614	.022	.017	.007
2020_4 (5.862 news)	.093	.747	.043	.052	.065
2021_1 (8.472 news)	.037	.131	.202	.03	.6
2021_2 (9.910 news)	.047	.057	.634	.131	.131
2021_3 (8.194 news)	.059	.028	.312	.57	.031
2021_4 (5.528 news)	.175	.029	.084	.643	.069

Source: Author's elaboration

The Gamma values for each period are as follows:

2020_1: In this initial period, Topic 1 dominates with a Gamma value of 0.95, indicating a clear thematic concentration around this topic. This suggests that media coverage was concentrated on a specific narrative, likely related to the announcement of the pandemic.

2020_2: Although Topic 1 remains the strongest (0.863), Topic 2 starts to gain relevance (0.133). This reflects a diversification in the narrative, possibly due to increasing discussions about vaccine development, health measures, and the progress of the pandemic.

2020_3: The landscape changes significantly, with Topic 2 emerging as the most predominant (0.614), while Topic 1 drops to 0.34. This shift may be related to the emergence of new narratives on other topics.

2020_4: Topic 2 continues to dominate with a Gamma value of 0.747, but other topics such as Topic 3 (0.043) and Topic 4 (0.052) begin to gain more strength. This period coincides with the approval of the first vaccines globally and the planning of vaccination campaigns.

2021_1: In this period, Topic 5 becomes the most relevant (0.6), while Topic 3 gains significant value (0.202). This could be related to the start of mass vaccination campaigns in Mexico, social expectations about immunization, and actions directed toward particular social sectors.

2021_2: Topic 3 dominates with a value of 0.634, while Topic 4 (0.131) also gains relevance.

2021_3: In this period, Topic 4 becomes the most important (0.57), and Topic 3 maintains its relevance, although the presence of the remaining topics is significantly reduced.

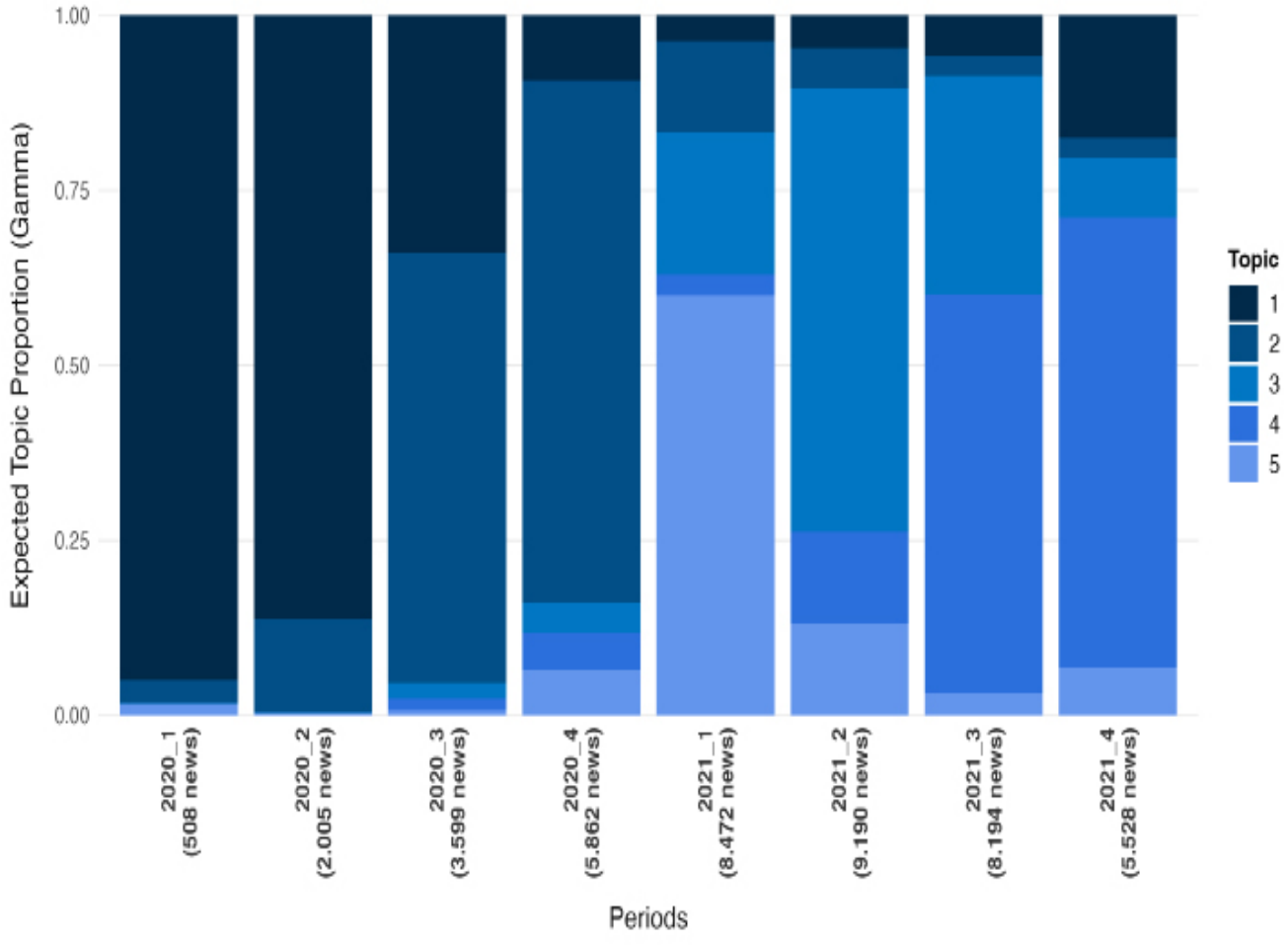

Figure 2. K=5 model of topic distribution in COVID-19 vaccine news in Mexico (2020-2021)

Source: Author's elaboration

The identification of Gamma and Beta values in the LDA model allows for a detailed description of thematic transformations over time in the Mexican context. Gamma reveals the evolving relevance of topics across quarters, highlighting fluctuations in media coverage due to events and social dynamics. Beta, which shows the word distribution within each topic, links these topics to relevant social, political, and health issues of the time. This approach enhances

our understanding of how thematic frames around COVID-19 developed, reflecting changes in public perception, health policies, and social responses. By contextualizing the results within Mexico's reality, we can identify shifts in media priorities and public concerns as the pandemic progressed and new policies were enacted. The following description of Figure 2 examines the k=5 model, offering a detailed view of topic distribution.

Discussion

The evolution of topics over the study period reveals a dynamic reconfiguration of media framing throughout the pandemic, rather than a mere chronological shift in coverage. In the early months, when COVID-19 emerged as a global crisis, media coverage focused on the dramatic aspects of the virus's spread, containment measures, and international efforts to curb the disease (Kohring & Matthes, 2002). This initial emphasis reflects a dominant crisis framing centered on uncertainty, risk, and global interdependence. As case numbers rose, alongside warnings about health system collapse and increasing mortality, media attention turned to the global response, economic fallout, and the social implications of lockdowns. These patterns suggest a consolidation of frames oriented toward systemic risk and collective vulnerability.

However, as the pandemic unfolded and local and national mitigation strategies were implemented, media attention increasingly shifted to regional and local government responses. Public health policies, such as the implementation of epidemiological "traffic lights," the vaccination campaign, and mobility restrictions, became recurring topics. More importantly, this transition indicates a shift from global crisis framing toward governance and responsibility frames. In addition, media narratives began to highlight differences in how various governments handled the crisis, including vaccine distribution, care for vulnerable populations, and economic measures to mitigate the pandemic's adverse effects. This differentiation across actors reflects the growing politicization of health communication and the attribution of responsibility within national contexts (Günther et al., 2020).

As the health situation stabilized in some regions, media attention turned toward economic and social recovery efforts. Topics such as returning to "normal" and the gradual reopening of economic, educational, and cultural activities gained increasing prominence in media narratives. Discussions around economic reactivation, mass vaccination, and adapting to new forms of social interaction became central in subsequent quarters. Rather than simply indicating a new pandemic phase, this shift can be interpreted as the emergence of normalization frames, in which the pandemic is reframed as a manageable condition within everyday life. Inequality and poverty, key concerns in the early months of the pandemic, remained central, particularly considering the disproportionate impact on the most vulnerable sectors of the population. This persistence highlights the structural dimension of the crisis and the limits of recovery narratives in highly unequal contexts. Overall, media coverage demonstrated how the dominant themes transitioned from a global health crisis to a more localized focus, emphasizing strategies for living with the pandemic in a new social context (Milutinović, 2021; Bhatti et al., 2022).

Nevertheless, the news coverage generally did not offer a critical analysis of the health policies and regulations enacted during the pandemic. This finding suggests a predominance of uncritical or supportive framing of public health measures. This resulted in informational bias, as public health measures were presented as inherently effective without rigorous evaluation of their actual efficacy, limitations, or potential unintended consequences (Solvoll & Høiby, 2023). Such framing reduces the plurality of perspectives and limits the deliberative function of the media. The absence of in-depth analysis prevented meaningful comparisons with alternative strategies adopted in other countries and excluded public debate about possible improvements or adjustments. This lack of scrutiny limited the audience's ability to access

a more balanced and well-founded perspective, thereby constraining their capacity to form informed opinions about the management of the health crisis.

In this regard, it is essential to draw on key contributions from the field of health communication, which for decades has emphasized that access to information alone does not ensure informed decision-making, especially in contexts of high uncertainty and misinformation (Neuhauser & Kreps, 2003; Rudd et al., 2007). Health literacy, understood as people's ability to access, understand, and use health-related information, is a critical pillar in responding to crises like COVID-19. However, this challenge cannot be resolved solely through health education: t also requires examining how media frames structure the conditions under which information is interpreted and acted upon. In this sense, framing studies allow for an understanding of dominant narratives, thematic emphases, and key omissions that shape public discourse around health.

The coverage evolved from an initial focus on the global health and economic crisis toward a narrative dominated by national public health policy and the logistics of vaccine application to specific social groups

Furthermore, framing theory provides a well-established framework for analyzing how media narratives influence public opinion. Frames organize information and guide interpretation by emphasizing certain aspects over others (Entman, 1993). Numerous studies have shown that media frames can significantly affect how people perceive issues, assign responsibility, and form attitudes toward policies or public figures. In this study, the identification of dominant frames, many of them politically oriented and with limited scientific grounding, points to the central role of the media in structuring public understandings of vaccination. By identifying the dominant frames in vaccine-related coverage, many of which were highly political and lacked scientific grounding, this study sheds light on the potential influence of the media in shaping public understandings of vaccination, trust in institutions, and perceptions of governmental action during the crisis.

Therefore, although this research does not directly assess audience effects, it rests on a solid theoretical foundation that supports the idea that media framing does shape public opinion, particularly in moments of crisis when people rely heavily on media to make sense of complex and evolving events. It is also important to emphasize that this study does not examine the effects of media frames on audiences, but rather how these frames are constructed in the media over time, particularly in relation to COVID-19 vaccines. The contribution of this study lies in revealing the temporal and thematic structuring of these frames, providing a basis for future research on their potential effects on perception, trust, and decision-making.

Conclusions

The application of LDA topic modeling in this study provides a novel, data-driven approach to tracking the temporal evolution of vaccine-related media frames in Mexico, revealing how thematic narratives shift in response to social and epidemiological developments. This temporal mapping not only uncovers the political dynamics and potential informational biases within media coverage but also highlights the critical role of media in shaping public perception, trust, and behavior during health emergencies. By identifying distinct phases, from global crisis framing to localized public health policy discussions, this research informs the design of culturally sensitive and timely communication strategies tailored to evolving public concerns.

Moreover, the findings advance theoretical understanding of media framing by illustrating how dominant narratives reflect and influence socio-political contexts, thereby affecting institutional trust and vaccine acceptance. The study underscores the importance of bridging the gap between scientific evidence and media narratives to mitigate misinformation and enhance public engagement. These insights have practical implications for health communicators and policymakers

aiming to develop interventions that promote media literacy, critical evaluation of information sources, and transparent institutional communication.

Acknowledging methodological limitations, such as the exclusive focus on media content and the constraints of automated topic modeling, this research lays a foundation for future mixed-method studies that integrate audience reception and qualitative analysis. Such approaches could deepen understanding of the complex interplay between media frames and public attitudes, further strengthening communication strategies in health crises.

In sum, the analysis of media coverage on COVID-19 vaccines using topic modeling (LDA) identified dominant thematic frames and their evolution over time in response to social and epidemiological changes. The five-topic model balanced thematic diversity and coherence, providing a nuanced understanding of how media narratives shifted. This research is a novel contribution, as it systematically explores the temporal evolution of vaccine-related media discourse, an area not previously addressed. It also highlights the potential of computational tools like LDA to reveal latent patterns in large text corpora, offering valuable insights for future public health communication strategies. In particular, the study contributes to the field of health communication by providing an empirical and data-driven approach to identifying how media frames evolve during health crises, thereby informing more effective communication strategies in contexts of uncertainty.

The findings underscore the political nature of vaccine coverage in Mexico and the presence of frames that were sometimes more aligned with institutional narratives than with evidence-based public health guidance. This highlights the potential for informational bias in health reporting, which may limit audiences' ability to make informed decisions and could exacerbate vaccine hesitancy or mistrust in institutions. From the perspective of health communication, these results emphasize the importance of developing timely, accurate, and context-sensitive media strategies that counter misinformation and strengthen public understanding during health crises. These findings align with the broader objectives of health communication research by demonstrating the need to bridge the gap between scientific evidence and media narratives in order to improve public engagement and informed decision-making.

Furthermore, this study illustrates that media transmits information and actively shapes the public's perception of risk, responsibility, and appropriate action. By identifying and characterizing dominant frames in vaccine-related news, the research contributes to understanding how information flows can either support or hinder effective health responses. These insights are directly relevant to the dossier's focus on health disinformation, demonstrating the need for interventions that enhance media literacy, promote critical evaluation of news sources, and encourage transparent communication between institutions and the public. In this sense, the research provides practical and theoretical foundations for designing communication policies aimed at mitigating risks associated with misinformation during pandemics or other health emergencies. However, this study has some limitations. First, the analysis is restricted to media content and does not assess audience reception or the effects of framing on public attitudes and behaviors. Second, the use of automated methods such as LDA, while useful for identifying large-scale patterns, may overlook contextual nuances that require deeper qualitative interpretation. Future research could address these limitations by integrating mixed-method approaches and examining the relationship between media frames and audience responses.

Author contributions

The authors equally participated in the preparation of the manuscript and approved the final version presented.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Data Availability Statement

The data presented in this study are available upon request from the corresponding author.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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