An analysis of science communication about COVID-19 vaccination in Portuguese online news media

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Abstract

This study aimed to analyze the usage of scientific concepts and technical terms related to COVID-19 vaccination in Portuguese online news sources and examine citizens' comprehension of these terms. A retrospective descriptive study was conducted, examining Portuguese news articles about COVID-19 vaccination from November 2021 to January 2022. Scientific terms were extracted from 190 articles, and seven citizens provided identification and brief definitions of familiar terms. Approximately 68% of the news articles involved collaboration with researchers or health professionals. A total of 144 scientific terms were identified in 77% of the articles, with more than half (57.54%) of these terms being unknown or inadequately defined by the citizens consulted.

Keywords

Citizen science; Health communication; Public understanding of science and technology

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Introduction

The World Health Organization (WHO) declared the novel coronavirus (COVID-19) a pandemic on 11 March 2020. This public health crisis resulted in an unprecedented flow of information and misinformation about the virus.

With no solid evidence about the novel coronavirus to guide behaviors and inform political decisions, people devoted a significant amount of time to consuming news related to the virus [Casero-Ripollés, 2021; O. E. Magalhães et al., 2021; Mheidly & Fares, 2020].

Research conducted by the Reuters Institute for the Study of Journalism, the Oxford Internet Institute, and the Oxford Martin School provided essential insights into the platforms people used and trusted for COVID-19 information and their perceptions of these platforms [Nielsen, Fletcher, Newman, Brennen & Howard, 2020]. Spanning six countries (Argentina, Germany, South Korea, Spain, the United

Kingdom, and the United States), this study found that people sought information about COVID-19 through various avenues, including social media platforms, websites, videos, and applications. Respondents identified scientific journals, newspapers, and press websites as the most trustworthy sources [Nielsen et al., 2020].

Other studies have also emphasized the pivotal role of online news sources in science communication and in countering misinformation and incorrect behaviors [Espanha, 2009; Lipworth, Kerridge, Morrell, Forsyth & Jordens, 2015; Anwar, Malik, Raees & Anwar, 2020]. However, media reporting can become problematic when addressing controversial scientific topics. A prominent example is the widespread media coverage of the 1998 Lancet report linking autism with the measles, mumps, and rubella vaccine, which fueled the anti-vaccination movement, despite the study's discrediting and subsequent retraction in 2010 [O. E. Magalhães et al., 2021].

The media played a crucial role in disseminating information about the virus, including scientific findings and reliable information from official health and government authorities [Casero-Ripollés, 2021; Cheng & Espanha, 2021]. This is supported by numerous studies that have explored communication strategies by analyzing COVID-19-related information in the media, including the virus and vaccines [Lopes, Araújo, Magalhães & Sá, 2020; Lopes, Araújo & Magalhães, 2021; Rodrigues, 2023; Schiavo, 2020; O. E. Magalhães et al., 2021].

A thematic analysis of 612 news articles published from January to March 2020, covering the early stages of the COVID-19 outbreak in Portugal, identified two distinct news profiles: one focusing on the epidemiological situation and the other on response measures to the pandemic [Rodrigues, 2023]. Despite the efforts of Portuguese television, radio, and newspaper journalists to ensure the quality of information through specialized sources sharing their 'wise knowledge' [Lopes et al., 2020], an analysis of health information in 2,037 Portuguese news articles about COVID-19 during the states of emergency declared in 2020 highlights differences between the work of journalists, scientists, and politicians and how their discourses can influence public opinion [Lopes et al., 2021].

Regarding COVID-19 vaccination in Portugal, a study aimed at exploring the strategies adopted by official sources during the pandemic found that most content fell into the 'institutional news' category. This content was primarily disseminated through statements from the National Health System on their website and social media pages [O. E. Magalhães et al., 2021]. The authors point out that despite the content's intended audience being the general public, these sources still maintain a conservative communication style, missing the opportunity to fully utilize the potential of the virtual environment for educational communication.

Numerous factors contribute to the complexity of science communication in health: i) scientific information is inherently complex, requiring different science communication strategies due to varying levels of understanding and literacy among citizens; ii) the science communication process involves uncertainty because science is dynamic and ever-evolving; iii) social influences significantly impact the understanding of science, including cultural beliefs, attitudes, and behaviors of individuals [Fontaine et al., 2019; Wagenknecht et al., 2021].

Science must be communicated to the public in an accessible and understandable language to support effective public decision-making. Exploring how information about COVID-19 was produced, shared, and consumed is a critical aspect of scientific treatment essential for the dissemination of any science-related subject [Bin Naeem & Kamel Boulos, 2021; Rodríguez & Giri, 2021].

One of the primary commitments of the European Union [Posetti & Bontcheva, 2020] is the encouragement of active citizen participation in scientific and technological activities. This is believed to be a crucial pathway for citizens to enhance their scientific and health literacy, develop their information research skills, and enable researchers to produce, engage with, and communicate innovative and valuable knowledge [Bailey, Salmon & Horst, 2022; Dempster, Sutherland & Keogh, 2022; Serpa, Ferreira, Sá & Santos, 2021]. In this process, citizen science (CS) facilitates scientific education, promotes public engagement, and helps overcome the challenges of scientific communication and dissemination [Giardullo et al., 2023; J. Magalhães et al., 2022]. It is crucial for democratizing science and promoting universal and equitable access to scientific knowledge. The paradigm proposed by CS is collaboration between science communicators and the general public [de Sherbinin et al., 2021; Fontaine et al., 2019; Wagenknecht et al., 2021].

In Portugal, several studies have explored the influence and role of the media during the pandemic [Pinto, Oliveira & Silva, 2021; Cheng & Espanha, 2021], the impact of specialized sources in promoting a more rigorous discourse [Lopes et al., 2020; Entradas, 2022; Lopes et al., 2021; O. E. Magalhães et al., 2021], the content of news articles [Rodrigues, 2023], and the role of social media in spreading information [Cheng & Espanha, 2021]. Therefore, focusing on sources and the communication strategies used by Portuguese news outlets and their influence on public perceptions would contribute to a better understanding of science communication, particularly in times of crisis.

To this end, the following questions were formulated: i) How did Portuguese online news sources communicate information about COVID-19 vaccination? ii) Which scientific concepts about COVID-19 vaccination were used in Portuguese online news articles? iii) What terms in online news articles are representatives of the public readership familiar with?

This study aimed to 1) analyze the use of scientific concepts and technical terms about COVID-19 vaccination in Portuguese online news sources and 2) explore citizens' understanding of the scientific concepts and technical terms in the news articles.

Methodology

A retrospective descriptive study was conducted to identify and select news articles published from 1 November 2021 to 31 January 2022 about COVID-19 vaccination in Portugal.

This period was selected for two reasons: i) the emergence of the Omicron variant; ii) and the start of COVID-19 vaccination for children, triggering discussions in the scientific community and civil society.

The search was conducted using the Google News search engine. A tool with full-text information sources that provides access to reliable websites [Haneef, Lazarus, Ravaud, Yavchitz & Boutron, 2015]. This tool also allows narrowing the search results by region and date. Other studies have use it to analyze online news coverage [Young Lin & Rosenkrantz, 2017; Dempster et al., 2022].

The Portuguese search terms for the following English terms were used: COVID-19 and vaccines and science or COVID-19 and vaccination and science. These terms were *"COVID-19" and "vacinas" and "ciência"* or *"COVID-19" and "vacinação" and "ciência"*. The inclusion criterion was established as follows: news articles published by the Portuguese press that addressed the topic of COVID-19 vaccination. The selected news articles were published in the following national circulation newspapers: *Público*, *Observador*, *Diário de Notícias*, *Jornal de Notícias*, *Sábado*, *Sapo*, *Jornal de Negócios*, *Saúde Mais*, *O novo*, *NIT* and *Expresso*.

Through Google News search we obtained 251 news articles. Of these, 26 were excluded for being duplicates, 15 for not being available in full text (despite efforts to obtain them), and 20 for not meeting the inclusion criteria. The total sample consisted of 190 news articles about COVID-19 vaccination in Portugal.

In the first stage, three authors read the news articles in full and organized the content taking into account the following categories: i) if scientific concepts were used; ii) which scientific concepts were used; iii) if the scientific concepts were defined; iv) if a researcher, academic, or health professional had collaborated in creating the news articles (through interview or quotes in press releases).

The researchers took a broad view of what could be considered as a scientific concept. Scientific concepts were considered to be any terminology related to science and technology.

Table 1 exemplifies some scientific concepts and definitions identified in the news articles.

Following the principles of greater citizen involvement in research, a citizen consultant participated in designing this study and screening the initial list of scientific concepts. They suggested involving a group of citizens in the project to review the list of scientific concepts and then identify the ones they knew and define them. We selected seven citizens through a convenience snowball sampling technique and presented them with a list containing scientific concepts ($n = 144$) that were not defined in the body of the news articles.

The citizens were aged between 31 and 78 years and had completed 4th grade ($n = 1$), 9th grade ($n = 1$), secondary education ($n = 2$), or higher education ($n = 3$). These citizens were researchers in the project *Ciência Cidadã: do fazer ao comunicar ciência na ótica do cidadão* (Citizen Science: from doing to communicating science from the citizen's perspective), which met the ethical requirements and was approved by the Ethics Committee under Opinion P886_06_2022.

The news articles and their content were coded and categorized. Descriptive statistics were used to analyze this media data. The concepts validated and interpreted by the seven citizens were organized and structured in a listing presented according to their interpretation classification.

Table 1. Scientific concepts used in the analyzed news articles.

		News articles		
Scientific concept	***Definition***	***Source***	***Date***	***Title***
Myocarditis and pericarditis	*"Myocarditis and pericarditis are inflammations of the heart. The former affects the myocardium — the main muscle of the heart — and the latter affects the pericardium — the membrane that surrounds the heart."*	Público	11/2021	*COVID-19: French health authority does not recommend MODERNA vaccine for people aged under 30*
Immunogenic	*"whether the vaccine is immunogenic, that is, whether it activates the immune system"*	Jornal de Notícias	11/2021	*More than 100 volunteers are ready to test the Portuguese vaccine*
IgG	*"one of the classes of antibodies produced by our immune system against SARS-CoV-2"*	Público	12/2021	*Population living in Portugal with 86.4% immunity against SARS-CoV-2*
Megakaryocytes	*"the bone marrow cells that produce platelets"*	National Geographic	12/2021	*How COVID-19 affects the heart*
Flurona	*"The term designates simultaneous infection with COVID-19 and influenza"*	VISÃO SAÚDE	01/2022	*What is known about 'flurona', the double infection of COVID-19 and influenza*
Ribosomes	*"cell structures where proteins are made"*	CNN Portugal	01/2022	*mRNA, the messenger that fights COVID-19 and prepares to stop other diseases*

Results

Characterization of the news articles

This study found that around 68% of news articles had the collaboration of researchers/health professionals, mainly through interviews or quotes in press releases (Table 2). Only one news article — an opinion article — was written in full by a health professional.

Around 77% of the news articles used scientific concepts but 45.79% of them did not define the concepts. Although most scientific concepts were used in November (31.58%), they were only defined in 7.9% of these news articles (Table 3).

Table 2. Participation of researchers/health professionals in creating the news articles. Source: study data.

	Yes		**No**	
Month	*n*	%	*n*	%
January	52	27.37%	12	6.32%
December	29	15.26%	17	8.95%
November	49	25.79%	31	16.31%
Total (*n*)	130	68.42	60	31.58

Note: *n* = news articles; % = relative frequency.

Table 3. Use and definition of scientific concepts. Source: study data.

	Yes		No		Does not apply	
	n	%	*n*	%	*n*	%
Use of scientific concepts						
January	49	25.79%	15	7.9%	–	–
December	38	20.00%	8	4.21%	–	–
November	60	31.58%	20	10.52%	–	–
Total	147	77.37	43	22.63	–	–
Definition of scientific concepts						
January	35	18.42%	18	9.47%	11	5.78%
December	16	8.42%	23	12.10%	7	3.69%
November	15	7.9%	46	24.22%	19	10%
Total	66	34.74%	87	45.79	37	19.47

Note: *n* = news articles; % = relative frequency.

Interpretation of the scientific concepts

After this analysis, the seven citizens recruited for the project were asked to review the list of 144 scientific concepts that were not defined in the body of the news articles. From the revised list, these citizens reported not knowing 30.55% ($n = 44$) of the scientific concepts. Of the remaining terms, 69.45% ($n = 100$), initially identified by the citizens as known, it is noteworthy that only 42.36% ($n = 61$) were adequately defined. In other words, despite claiming familiarity with the terms, 27.09% ($n = 39$) of the presented concepts were inadequately or insufficiently defined by the citizens.

This categorization can be observed in the figures presented below, which show the word's list composed of the scientific terms analyzed by the citizens.

Figure 1 shows the scientific concepts in the news articles with which citizens were unfamiliar (30.55%).

1. interleukin-6 antagonists
2. seroprevalence
3. messenger RNA
4. adenovirus
5. polymerase
6. monoclonal antiviral drugs
7. monoclonal antibodies
8. adjuvant
9. spicule protein
10. humoral immunity
11. Interferon-Gamma concentration level
12. S-gene
13. serum antibodies
14. pro rata
15. adverse effects on the immune system
16. endemicity
17. lab-grown version
18. spike protein
19. Non-coding region
20. primary vaccination schedule
21. coronavirus deactivated
22. dose provided
23. pathogen
24. Pharmacovigilance
25. Clusters
26. virus-specific protein
27. immune thrombocytopenia
28. Genome sequencing
29. genomic sequences
30. virus neutralization activity
31. viremia
32. effectiveness
33. probiotics
34. lymphocytes
35. T cells
36. chemical deactivation
37. neutralizing antibodies
38. genome
39. enzymatic conversions
40. genomic sequencing
41. genetic diversity
42. antigen
43. multisystem inflammatory syndrome
44. morbidity

Figure 1. Scientific concepts unknown to the citizens. Source: authors.

These concepts are associated with the pandemic situation. Despite being widely disseminated and often used in discussions on several platforms, citizens without formal university scientific training may still be unfamiliar with them, mainly because they are not adequately defined in the news articles. It is understandable that in the face of technical terminology and a specific context, terms such as "interleukin 6 antagonist", "polymerase", or "adenovirus" are classified as unknown by individuals who are not directly involved in the field of health or do not have experience in this field.

Figures 2 and 3 present the scientific concepts that were mentioned by the participating citizens as "known terms". However, it is important to highlight that Figure 2 consists of the "known scientific concepts" that actually had a corresponding definition to their meaning (42.36%), while Figure 3 shows the concepts that the citizens reported knowing, but the described meanings do not correspond to the most appropriate definition available in the literature (27.09%).

Citizens recognized concepts such as *endemic disease*, *second-generation vaccines*, *cellular immunity*, or *coronavirus* due to the frequency with which this topic was reported and discussed. However, the citizens' definition did not match the definition found in the literature (Table 4).

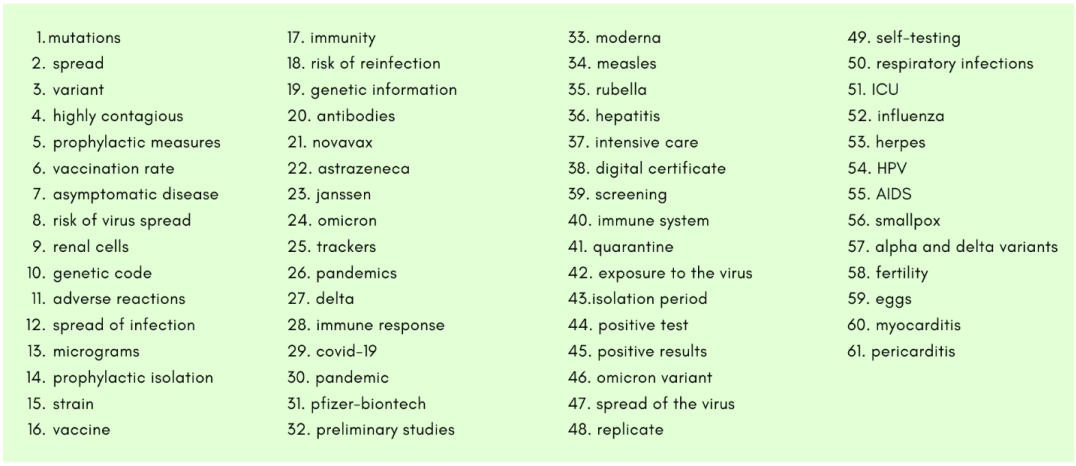

Figure 2. Scientific concepts known by the citizens. Source: authors.

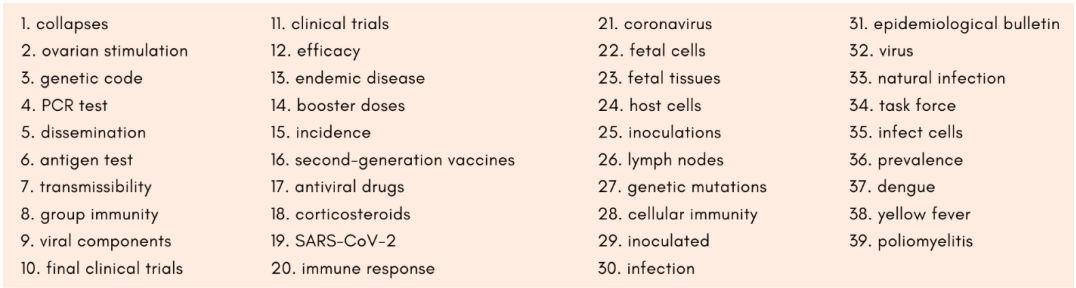

Figure 3. Scientific concepts inadequately defined by the citizens. Source: authors.

Table 4. Citizens' definition of the scientific concepts and technical terms.

Scientific concepts and technical terms	Definition
Endemic disease	*"it's a skin disease."* Citizen 1
Booster doses	*"it's to take two doses."* Citizen 4
Task Force	*"it's the plan that the colonel made."* Citizen 1 *"The admiral in charge of vaccination in Portugal."* Citizen 5
Poliomyelitis	*"it's polyps."* Citizen 4
Virus	*"it's filth we have inside."* Citizen 3
Inoculation	*"mutations, viruses."* Citizen 1
Cellular immunity	*"it's from the sun."* Citizen 4
Second-generation vaccines	*"vaccines that are done in a sloppy way. Carelessly"* Citizen 7
Host cells	*"children who have no symptoms but have the virus."* Citizen 2
Fetal tissue	*"it's from the anus/feces, it's from the monkey virus."* Citizen 1
Coronavirus	*"it's an infection, a Chinese virus made in a laboratory."* Citizen 7
Lymph nodes	*"breast cancer cells; located in the neck area."* Citizen 5
Infection	*"the little creatures that are everywhere, for example in fruits, body, virus."* Citizen 7

Discussion

According to the objective of analyzing scientific communication about COVID-19 vaccination in Portuguese online news sources and exploring which scientific terms readers are, or are not, familiar with, this study found that the language used in the news articles over a three-month period was not sufficiently clear for the understanding of some citizens. The identified news articles inevitably relied on specific and technical terminology related to the COVID-19 virus and the vaccination process, but these terms were not always defined.

Furthermore, despite efforts to disseminate scientific findings to inform and raise awareness among the population in combating and minimizing the impacts of the pandemic, a large part of the terminology identified in the news articles was unknown or poorly understood by the consulted citizens.

Public health has been threatened by misinformation on the media, anti-vaccine movements, or even the promotion of potentially lethal substances to prevent or treat COVID-19, which have called into question the available scientific knowledge and threaten public health [Rodríguez & Giri, 2021]. For this reason, news media are essential in disseminating information and raising awareness about public health crises [Gupta, Sharma, Najm & Sharma, 2020], with two key factors for the success of scientific communication in the media being the pursuit of the best available evidence and the use of accessible language.

Scientists, health professionals, and health authorities are responsible for communicating the scientific knowledge produced to different target audiences. The communication process aims to ensure that the information is available, accessible, understandable, and actionable [Reddy, 2021; Van den Broucke, 2020].

It is important to highlight that when it comes to science communication in the health field, journalists typically prefer specialized sources, whether they are

researchers, academics, or healthcare professionals and organizations, due to the credibility they bring to the news discourse [Lopes et al., 2020].

Although this study analyzed the involvement of specialized and credible sources in the creation of news articles, this characteristic was not used as an inclusion or exclusion criterion.

The language used in news articles about COVID-19 vaccination included numerous complex concepts and terms unfamiliar to the seven citizens involved in this study. This was necessary to address the new global situation and disseminate the latest scientific evidence. Similar findings were also reported in previous studies [Antiochou, 2021; Riggs, Shulman & Lopez, 2022]. However, the inevitable use of scientific concepts (present in 77% of the analyzed news articles) can lead to public mistrust [Antiochou, 2021].

In this context, the work carried out by the news sources in contextualizing and informing about health and disease issues becomes compromised, since an informed and safe decision-making process by citizens requires clarity and accuracy [Lopes et al., 2020].

Another aspect focuses on widely disseminated scientific concepts that were unfamiliar to or inadequately defined by the citizens. Given the close connection between the realms of communication and health literacy, this study confirms the importance of factors such as clarity and accessibility. The use of complex, technical, and formal vocabulary can exclude individuals who do not understand the information [Novak, Becker, Grey & Mondardini, 2018; Riggs et al., 2022; Rüfenacht et al., 2021].

Citizens recognize complex concepts due to the pandemic situation and the frequency with which this topic is discussed both in the media and in various informal settings. However, the widespread dissemination and the feeling of familiarity with these concepts do not guarantee that their meaning is understood, as evidenced by the results of this study.

Research conducted in the field of health promotion, health literacy, and crisis communication [Espanha, 2020; Sentell, Vamos & Okan, 2020; Van den Broucke, 2020] highlights that factors such as low education and low health literacy influence the perception and adoption of health risk behaviors, especially during public health crises, as exemplified by the COVID-19 pandemic. However, the available literature underscores the crucial role of language in this process, as the scientific language not only affects comprehension but also influences people's engagement with scientific information [Krieger & Gallois, 2017; Shulman, Dixon, Bullock & Colón Amill, 2020].

In Shulman et al.'s [2020] experiment involving 650 participants, the authors explored elements of metacognition and self-perception to explain why scientific concepts negatively impact community members' engagement with scientific topics. They discovered that even when concepts are accompanied by definitions, their use continues to have negative effects. While technical language is essential in specific contexts, it often creates distance and limits accessibility outside the circle of experts, thus diminishing its potential to positively influence decision-making processes [Krieger & Gallois, 2017].

In addition to the significant need for deciphering scientific concepts and technical terms [O. Magalhães, Lopes & Araújo, 2020], it is crucial to emphasize the responsibility of journalists in disseminating accurate information that minimizes the emergence of erroneous ideas, doubts, and prejudices of any kind [Forsyth et al., 2012, p. 131].

Tolochko, Song and Boomgaarden [2019], Bullock, Colón Amill, Shulman and Dixon [2019] and Riggs et al. [2022] also discovered that the use of complex language with scientific concepts posed challenges for citizens in understanding the information. Riggs et al. [2022] observed that visual formats aided comprehension, a feature not found in the analyzed news articles. Regarding communication about COVID-19, the lower levels of health literacy in certain groups may necessitate alternative communication strategies, such as different formats, styles, or additional clarification [Sentell et al., 2020].

From a different perspective, Shulman and Bullock [2020] assessed the use of scientific concepts in science communication during emergency situations. The authors examined three scenarios: i) COVID-19, ii) flood risk, and iii) United States emergency policy, categorizing them by levels of urgency. COVID-19 was considered a high-urgency situation, flood risk a low-urgency situation, and emergency policy a control condition. The authors found that employing scientific concepts in high-urgency situations like the COVID-19 pandemic did not impede comprehension. Conversely, the opposite was observed in the less urgent topics, leading to the conclusion that simplifying concepts in crisis communication may not be necessary [Shulman & Bullock, 2020].

However, the results of this study may suggest that communicating scientific concepts without clear definitions can be problematic, as citizens' interpretation of familiar scientific concepts is not always accurate.

This study also indicates that the absence of clear definitions for scientific concepts impedes understanding. This "misconception" can lead to biases about the origin of the virus, such as labeling it "the monkey virus" or "a Chinese virus made in a laboratory", and may erode trust in science".

It is understood that in the process of conveying scientific findings to the public, journalists and media outlets responsible for the news often rely on specialized and reliable sources, such as official statements from health authorities or excerpts from interviews with scientists and healthcare professionals [Lopes et al., 2020]. This reliance on experts may contribute to the use of more technical language. However, the premise here is not that scientific concepts should be avoided in reporting, but rather that there should be a concerted effort to simplify the communication of science and scientific knowledge. When such concepts are used, there should be a commitment to providing clear and accessible definitions, as it is through this process that scientific knowledge is shared, understood, and applied by citizens in their daily lives [Reddy, 2021].

Furthermore, it is important to highlight that only one news article (an opinion piece) was authored entirely by a healthcare professional. This raises the question that, just as scientists are under pressure to find answers to the COVID-19 pandemic, journalists are also pressured to convey information and publish stories

that generate revenue [Catalan-Matamoros & Peñafiel-Saiz, 2019]. In this context, the literature on science communication is clear and suggests that journalistic objectives can sometimes take precedence over public health concerns.

Studies indicate that in addition to prioritizing negative messages and occasionally providing inaccurate information, important aspects like research limitations and risks are often not given due attention in news articles [Catalan-Matamoros & Peñafiel-Saiz, 2019; Dempster et al., 2022].

While media discourse often adopts strategies that focus on the risks or negative consequences of specific interventions or behaviors [Ophir, 2018], successful health communication requires consideration of specific aspects [Finset et al., 2020; Noar & Austin, 2020; Vraga & Jacobsen, 2020]. The relationship between journalists, politicians, scientists, and healthcare professionals is pivotal in science communication and cannot be disregarded. It directly influences how information reaches citizens and, consequently, shapes public opinion on the subject [Casero-Ripollés, 2021].

Given that health communication aims to 'engage, empower, and influence individuals and communities' [Schiavo, 2014, p. 5] journalists are expected to ensure evidence-based news coverage by consulting specialized sources such as scientists, healthcare professionals, and even government authorities. These parties should recognize the importance of using plain language and defining specialized terminology associated with the benefits of preventive measures like COVID-19 vaccination [Schiavo, 2020].

Ultimately, a paradigm shift is crucial to combat misinformation and promote health literacy. In this regard, citizens should be engaged not only in planning communication strategies but also in designing and implementing public policies [Schiavo, 2020].

This study had some limitations. The restricted timeframe (three months) for the news search and the sole use of the Google News search engine on newspaper websites might not have allowed us to access all available news sources. In terms of implications for future research, further studies should aim to identify and categorize the scientific terminology used in social media posts (e.g., Facebook and Twitter). Additionally, these studies should explore how individuals involved in content creation and dissemination through both traditional media and social media networks — such as journalists, researchers, and healthcare professionals — approach the utilization of scientific terminology in their communication.

Conclusion

This study mapped the news articles about COVID-19 vaccination published in Portuguese online news sources between November 2021 and January 2022. The analysis revealed that scientific concepts were frequently used in these news articles due to the ongoing pandemic.

Despite their wide dissemination in the media, many of these concepts were unfamiliar to the citizens involved in this study, especially those terms that were not clearly defined in the analyzed news articles. Providing clear definitions of scientific concepts related to this newsworthy topic is a crucial strategy for

enhancing public understanding. Therefore, language plays a pivotal role in this specific context because news articles about COVID-19 vaccination served as a primary source of information for a significant portion of the population.

The social responsibility to inform and the exceptional nature of this pandemic present opportunities to raise citizens' awareness and promote health literacy through information dissemination.

The involvement of health professionals, researchers, and academics in creating news articles is an intriguing aspect of these findings, given that news and opinion articles authored by these professionals are relatively scarce.

The authors contend that science communication serves as a bridge for dialogue among researchers, citizens, media professionals, policymakers, and other stakeholders. Opening up the research process to citizen participation creates opportunities to bring society closer to science, raise citizens' awareness, improve decision-making, and enhance the value of science in society.

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