COVID-19 Vaccine Framing: The Case of AstraZeneca and Twitter Users

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Abstract

Framing of health messages on social media can impact health choices and behaviour such as vaccine uptake. The present study aimed to examine how AstraZeneca has been framed on social media, characterize Twitter users who have engaged in the distribution of health-related information about the AstraZeneca vaccine, and demonstrate the impact of various frames on user engagement. Tweets with a collective total of more than 159,000 words were gathered from tweets posted during the second and third week of March 2021 and analyzed using a cognitive linguistics approach, namely frame semantics. In addition, social media mining tools were employed to investigate user engagement. The findings indicate the presence of negative vaccination framing with three sub-systems: the vaccine (i.e., vaccination politics), the government's response to (in)effectiveness, and citizens (the vaccinated), which are known through public reaction. All frames represented AstraZeneca in a negative light and have implications on health professionals, policies, and practices. Furthermore, Twitter user analysis revealed a link between the condensed nature of the retweets about the AstraZeneca vaccine and the potential spread of health misinformation. The findings inform future researchers by providing a snapshot of how the public has dealt with recent news of the reported side effects of the AstraZeneca vaccine on social media. The study concludes that the findings provide useful information for understanding the impact of health messages on social media on influencing people's vaccine uptake.

1. INTRODUCTION

The general public uses social media to stay informed, connect with others, and share perspectives on different topics (Tang et al., 2018). Risk communication plays a crucial role in public health risk management, and is particularly important in areas of high concern or controversy, such as vaccination (see Freudenstein et al., 2020). In the context of the coronavirus (COVID-19) pandemic, social media platforms play a role in circulating news about vaccines. It has become commonplace for key figures, celebrities, and ordinary people

to post pictures of themselves getting vaccinated or details about their vaccination status on social media platforms. People also post about their concerns regarding the COVID-19 vaccines. Furthermore, news about the side effects of some vaccines has fueled people's fears of the unknown and raised doubts about vaccine effectiveness.Vaccine hesitancy is ignited by a variety of factors, including detrimental health effects (Lazarus et al., 2020). As a result, many researchers have asserted that COVID-19 vaccines are being described ineffectively, particularly when it comes to the utilization of wartime language to discuss the pandemic (Semino, 2020; de Saint Preux and Blanco, 2021; Schnepf and Christmann, 2022) This view is in line with cognitive science research findings, which indicate that the words used in media impact people's cognition (Kahneman & Tversky, 1984; Thibodeau & Boroditsky, 2013). Other researchers have shown that the COVID-19 pandemic has affected people so deeply that many use it as a source domain when talking metaphorically about various activities (Abdel-Raheem, 2021). For example, Eman Almutairi, a Saudi official, talks about the spreading of a good virus when describing policy reforms that facilitate Saudi women's empowerment and could extend to neighboring Gulf Cooperation Council countries. Another example concerns how media can be manipulated to affect vaccine uptake (see Abdel-Raheem and Alkhammash, 2021). Many controversies surrounding vaccines have arisen during the pandemic. Notably, the major side effects of the AstraZeneca vaccine, which were first reported in many European countries, have led to controversy. Many European officials have held press conferences to recommend suspending the use of this vaccine, and such news has not only increased anti-vaccine beliefs but also led many people to favor other vaccines over AstraZeneca's version. Many people have questioned the effectiveness of the AstraZeneca vaccine on social media. In addition, the vaccine has received escalating political tensions related to Brexit (Caliendo, 2022) and a connection has been suggested between the vaccine and reported cases of blood clots (European Medical Agency, 2021). Traditional media coverage has greatly contributed to the controversy surrounding the vaccine AstraZeneca. In a study of social media discourse on the AstraZeneca vaccine, Jemielniak and Krempovyc (2021) found that powerful media outlets have spread disinformation by retweeting negative news about the vaccine. In addition, social bots have been used to promote polarized opinions and spread misleading information about the vaccine (Broniatowski et al., 2018; Samuel et al., 2021; Shi et al., 2020). Broniatowski et al. (2018) identified social bots in online discussions about the pandemic and examined their role in spreading misinformation.As mentioned above, all of the media coverage surrounding the AstraZeneca vaccine's alleged low effectiveness makes it an especially compelling case study. Therefore, the present study examined how the AstraZeneca vaccine has been portrayed on social media. For example, discourse on the vaccine has featured negative topics, such as blood clots and side effects (Sattar & Arifuzzaman, 2021). Specifically, this study aimed to examine how AstraZeneca has been framed on social media, characterize Twitter users who have engaged in the distribution of health-related information about the AstraZeneca vaccine, and demonstrate the impact of various frames on user engagement. Specifically, this study addresses its main research question as follows: what risk frames have been employed by tweets during media frenzy over the AstraZeneca vaccine? Which tweets received the highest number of retweets and/or likes? What places became interested in tweeting using the hashtag under investigation? Which users in the dataset had the most tweets? and what is the relationship between the vaccine frame and user engagement analysis?

To achieve this objective, we investigated how risk has been framed in social media about AstraZeneca. The tweets were analyzed from three different angles: frame analysis, user engagement analysis, and the relationship between the vaccine frame and user analysis. Frame analysis was conducted to major frames. The second angle involved an examination of user engagement. This analysis utilized a dataset consisting of tweets containing news, fears, and rumors about AstraZeneca. The third angle focused on sampling the frames' engaging levels. The rest of the study is organized as follows. Section 2 describes a review of the literature on the role of social media during the COVID-19 pandemic. The data and methods used in the study are presented in Section 3. Sections 4, 5, and 6 present the results, discussion, and conclusion, respectively.

2. LITERATURE REVIEW

2.1 Misinformation on Twitter

Misinformation and disinformation are prevalent on Twitter. Misinformation can be defined as the intentional or unintentional spread of false information (Fetzer, 2004). In contrast to credible news sources, Vosoughi et al. (2018) have argued that misinformation is more widely circulated on Twitter because it contains new information (Vosoughi et al., 2018). The spread of incorrect information is facilitated by advanced communication technologies, which enable many people to share information easily (Apuke and Omar, 2021). Based on a quantitative analysis of one million tweets, Mourad et al. (2020) found that COVID-19-related communication on Twitter exploited the crisis by diverting readers' attention to non-COVID-related topics and enabled the widespread dissemination of erroneous medical information. Pennycook et al. (2020) presented evidence from two experiments to show that people share misinformation about COVID-19 in part because they misjudge the accuracy of the content before sharing it. In experiment 1, participants were significantly less adept at correctly judging true and false content when asked about the accuracy of the information before they shared it on social media. Additionally, stronger discernment was associated with increased cognitive reflection and scientific knowledge. In experiment 2, simply putting a reminder asking people to consider the accuracy of tweets at the beginning of the survey greatly contributed to improving the participants' intention to only share true content. Taken together, the findings suggest that encouraging people to judge the accuracy of social media content before sharing it with others is an easy way to minimize the spread of misinformation.In addition, misinformation on Twitter might be a politically motivated tactic that aims to influence people's views and decisions. In 2013, the World Economic Forum ranked misinformation as an important variable that affects financial status and relationships between countries (Giustini et al., 2018). Linvill and Warren (2020) analyzed the behavior of various Twitter handles and found that misinformation came from sources with different ideologies, such as the spread of right-leaning populist misinformation, left-leaning identity-based misinformation, gamer hashtags to recruit followers, and fearmongering misinformation.

2.2. Vaccine-related misinformation on Twitter

Vaccine-related misinformation has a significant impact on vaccine uptake. Studies have shown that some parents do not follow medical recommendations to vaccinate or immunize

their children due to misinformation (Kashyap et al., 2019). Nonetheless, many researchers have dubbed misinformation during the pandemic an infodemic because misinformation about COVID-19 has contributed greatly to its spread (Datta et al., 2020; Mourad et al., 2020). Furthermore, in a survey of medical and non-medical students in India, 50% of the participants agreed that distinguishing between correct and incorrect information about COVID-19 was difficult and that their attention had diverted away from decision making regarding their health as a result (Datta et al., 2020).

Misinformation about COVID-19 has many negative consequences; it can exacerbate people's fear of the pandemic and mislead them about the process of seeking proper medical practices. Furthermore, many people might follow incorrect advice on how to protect themselves from COVID-19, resulting in illness or death (Tasnim et al., 2020). One of the biggest consequences of misinformation has been an increase in vaccine hesitancy. Recently, Twitter has implemented policies that regulate the circulation of misleading information (Twitter Help Center, 2021). The COVID-19 Misleading Information Policy states the types of misinformation found on Twitter, which include conspiracy theories, alarmist discourse not based on research or credible reporting, and rumors (Twitter Help Center, 2021).

2.3. The language of misinformation

Sociolinguistic research has analyzed the language of two polarized vaccination communities on Twitter: pro-vaxxers who believe in the efficacy of vaccinations and anti-vaxxers who are opposed to vaccinations. The analysis of the data revealed significant linguistic variations between these communities, particularly in their use of linguistic intensifiers, pronouns, and words to indicate uncertainty. For example, pro-vaxxers used fewer intensifiers than anti-vaxxers. In addition, anti-vaxxers exhibited a considerably higher usage of pronouns, especially third-person, gendered third-person, subject, and object pronouns, than pro-vaxxers (Memon et al., 2020). In addition, network-level analysis revealed significant differences in network density, echo chamberness, and the External-Internal index, EI index, between the communities. The researchers hypothesized that these sociolinguistic distinctions could be used to characterize and comprehend these communities in order to develop more effective message interventions (Memon et al., 2020).

In a discourse analysis study, McNeill et al. (2016) investigated how the public in the UK viewed vaccination efforts against the H1N1 virus. Three events from the Twitter timeline, which coincided with Department of Health press releases, were selected: (1) the ordering of the vaccine, (2) the administration of the vaccine, and (3) the announcement of the vaccine administration start date. The study identified key terms used in the events and found that negative tweets about ordering the vaccine contained questions that encouraged readers to believe the government's decision to order the vaccine was not sound. Regarding the second event, the tweets criticized doctors' motives or accused the government of not being fair. Regarding the third event, the tweets stated that the people tweeting fell into a high-risk category or people who questioned being the high-risk cases that were eligible for vaccination (McNeill et al., 2016).

Chopra et al. (2021) conducted a computational lexical analysis of misinformation and hesitation regarding vaccines on Twitter. The study investigated the emotions of Twitter users for eight months during the rollout of COVID-19 vaccines and the administration of these

vaccines. Tweets containing conspiracy-themed words, including QAnon, implant microchips, flat earth, and conspiracy theorists, were identified in the dataset. These terms clearly indicated an association between vaccines and unexpected concepts in the minds of the public. In addition, hesitancy and misinformation regarding vaccination were correlated with negative emotions of the participants (Chopra et al., 2021) Hesitation is a lexical category that encompasses terms, such as skeptical, pushback, red flag, entitled opinion, and consequence, that convey misunderstandings about vaccines and their side effects.

Similarly, Entman (1993) used computational methods to investigate the language of anti-vaccine discourse related to COVID-19; data appears on Twitter in real time. A mathematical model was employed to investigate the co-occurrence of topics and their frequency in the discourse. Three major anti-vaccine topics were identified in descending order: debunking claims about the vaccine being a plot by rich people to reduce the world's population, vaccine safety, and strong and neutral sentiments toward vaccines (Entman, 1993).

3. Data and Methods

A total of 12,344 English language tweets (containing 159,000 words) about the AstraZeneca vaccine were collected retrospectively from 12 of March 2021 to 20th of March 2021 in the following manner. First, the tweets were extracted. Then, to verify that they were relevant to the research topic, important hashtags, such as #Oxford-AstraZeneca, #Oxford vaccine, and #AstraZeneca, were used as filters. Next, relevant tweets were retrieved using a google spreadsheet proposed by Alkhammash (2019). In the following subsections, details about frame analysis, Twitter user analysis, and frame and user engagement are presented.

3.1 Frame analysis

In the context of health communication, Freudenstein et al. (2020) investigated how risk is framed, specifically, whether framing risk communication messages as a risk assessment or a hazard identification results in changes in risk perception. Wehling (2013) classified frames into four distinct categories: (1) generic issue frames that do not directly address values, such as the War on Terror framing of anti-terrorism efforts; (2) generic value frames that invoke values that are not unique to conservative or liberal morality, such as free speech or public order; (3) morality-specific attitude frames that invoke moral attitudes derived from conservative or liberal values, such as opposition to immigration; and (4) moral frames that invoke concerns from conservative or liberal morality, such as purity and punishment. People are subjected to frames if the value concerns presented in those frames correspond to their moral worldview; Wehling (2013) referred to this as "moral relevance." In addition, availability, accessibility, and applicability influence the frames people use to think about politics (Wehling, 2013).

In the present study, WordNet was employed to conduct a systematic analysis of the frames found in the data (Fellbaum, 1998). WordNet is used to examine the meaning of a word by referencing a situational concept called a frame, which is composed of roles referred to as frame elements (Fellbaum, 1998). In cognitive linguistic traditions, words are viewed in terms of the frames that they invoke (Lakoff, 2010). In the present study, the most common keywords were generated using Sketch Engine, and WordNet was used to construct tables for each frame found

in the data (Kilgarriff and Baisa, 2022). Finally, I verified the results through close reading and manual checking of the data.

3.2 Twitter user analysis

Twitter offers access to different kinds of user information, such as names, locations, devices used, number of retweets, number of likes, and personal bios. Most of the time, it is a challenge to determine whether a Twitter account is authentic. Therefore, one needs to be cautious about making generalizations about users whose accounts are not verified. However, we can determine the nature of the data related to a research topic by summarizing Twitter users' behaviors and/or practices. For example, we can answer the following questions:

● Which tweets received more retweets and/or likes?

● What places, as stated by users, were active in tweeting about AstraZeneca?

● Who are the major influencing users in the dataset?

Such information enables a deeper understanding of the data and what it represents.

3.3 Frames and user engagement

To examine the relationships between frames and user engagement, a representative sample of the data related to each frame was analyzed, and level of engagement was measured by the number of retweets and the number of likes. A downsampling technique was used on tweets that had the majority of each frame's keywords (see Sönning and Krug, 2022) for the use of the downsampling technique in Corpus Linguistics.

4.   Results

4.1. Results of the frame analysis

A quantitative analysis of keywords in the dataset revealed that Twitter employed four frames when describing AstraZeneca: the failing medical intervention frame, the shifting commitment frame, the suspect frame, and the point of dispute frame. Since vaccines are promoted as helping to reduce the risk of hospitalization, a cure frame could not be invoked.

The four identified frames were multifaceted, contained many elements, and formed a consistent negative framing of AstraZeneca. The medical intervention frame had the following semantic roles: intervention (i.e., a drug or procedure that is administered or performed to treat a medical condition), medical condition (i.e., a holistic description of the medical state of a patient), medical professional (i.e., an individual or team that attempts to improve the medical condition of a patient), and result (i.e., a consequence of an intervention). The medical intervention frame also had the following non-core elements: extent (i.e., the degree to which an intervention affects the medical condition or symptoms), frequency of access (i.e., the regularity with which an intervention is effective for treating a medical condition or symptom(s), patient (i.e., an individual who receives a medical intervention to address a medical condition), and side effects (i.e., unintended or undesirable effects of an intervention).

As shown in Table 1, the medical intervention frame was invoked based on keywords linked to seven elements. The first element, intervention, included words in the dataset that referenced the vaccine. Notably, the second element, side effects, included all keywords used to describe the major side effects associated with the AstraZeneca vaccine. The third element, medical condition, contained keywords, such as COVID and coronavirus. The fourth and the fifth elements—medical professional and patient, respectively—all determined to be physicians,

and two patient age groups, respectively. The over-50 groups were prioritized for vaccination, and the under-50 group experienced the most major side effects. According to the keywords for the sixth element, extent, the AstraZeneca vaccine had positive descriptions, such as safe and risk-free, despite the reported side effects. Regarding the seventh element, result, the vaccine resulted in bruising as well as vaccine hesitancy, as indicated by the keyword hesitancy.

Table 1. The Medical Intervention Frame.

Element		Keyword	Total Frequency	Relative Frequency per million
Medical Intervention	Intervention	AstraZeneca	660	26913.8
		jab	1192	4348.2
		zeneca	107	390.3
		vaccination	731	2666.6
		vaccinate	302	1101.7
		rollout	201	733.2
		astra	123	448.7
		Oxford-AstraZeneca	52	189.7
		vacc	51	186
		vax	59	215.2
		vaccine	4952	18064.2
	Side effects	clot	963	3512.9
		hospitalized	117	426.80000
		thromboembolic	65	237.1
		bleeding	127	463.30000
		thrombo	7	5280
		venous	24	75601
		thrombocytopenia	38	138.60000
		thrombosis	24	87.50000

	ache	74	281804
	feverish	6	30096
	bruising	5	32851
	anaphylaxis	2	22430
Medical condition	COVID	273	995.90000
	coronavirus	214	592865
Medical professional	physician	117	1567177
Patient	over-50	221	806.2
	under-50	3	225
Extent	safe	41	149.60000
	risk-free	17	26677
	painless	11	71351
	safety	403	5989029
	sore	142	518
Result	headache	120	515460
	hesitancy	257	937.5

The commitment frame was invoked because side effects of the AstraZeneca vaccine were reported, and multiple European countries stopped using the vaccine. This frame had the following core elements: addressee (i.e., a person to whom something is addressed), medium (i.e., a physical entity or channel used to transmit a message), message (i.e., an expression of a commitment made by a speaker), speaker (i.e., a person who commits himself/herself to doing something), topic (i.e., a subject described using a noun). The commitment frame also had the following non-core elements: manner (i.e., the manner in which a commitment is made); period of iterations (i.e., the length of time from when a commitment event begins to be repeated until it stops); place (i.e., the location in which a speaker makes a commitment); purpose (i.e., an action during which a speaker makes a commitment); and time (i.e., the time during which a speaker makes a commitment) (see Fellbaum, 1998).

Interestingly, inconsistency was detected between the messages within the commitment frame, possibly resulting in the decoding of the complexity of the frame. For example, speakers, such as in India, Taiwan, and the HSE, were associated with messages supporting the administering of the vaccine, while other speakers, such as European countries, were linked to messages about

pausing the use of the vaccine. A shifting commitment within the frame usually implied that different speakers conveyed different messages regarding the vaccine.

As shown in Table 2, the first element, speaker, included 16 different speakers, ranging from countries to officials. The second element, message, had keywords, such as pause, administer, restart, and reiterate. The third element, medium, had keywords related to media outlets. The fourth element, manner, had four keywords, including deadly and unacceptable.

Table 2. The Commitment Frame.

	Element	Keyword	Total Frequency	Relative Frequency per million
		EU	1091	2016458
		regulator	424	685698
		Macron	38	67342
		Norway	180	560285
		European	1085	4881254
		France	566	3021130
		Germany	422	2903972
		Spain	114	1458561
	Speaker	Denmark	33	446586
		Netherlands	40	724268
		European	12	169094
Commitment		Anglo-European	3	990
		Austria	27	492144
		The HSE	51	186
		Taiwan	59	215.2
		India	4952	18064.2
		pause	963	3512.9
		administer	117	426.80000
		suspension	65	237.1
	Message	restart	5	28961
		holding	2	42
		wait	5	45
		threaten	11	137551
		blockage	9	106505

	Keyword	Total Frequency	Relative Frequency per Million
	resume	379	1478043
	halt	15	255222
	blame	2	956
	consent	6	32856
Medium	NYTimes	74	281804
	The cable	114	415.9
Addressee	Boris	58	192278
	unacceptable	221	806.2
	understandable	3	225
Manner	needlessly	6	48881
	deadly	39	654454

Twitter users expressed alarm in response to news about side effects of the AstraZeneca vaccine, including reports of deaths in many European countries. Tweets about filing a manslaughter case against AstraZeneca were widely circulated. In other words, the public invoked the want suspect frame. This frame has one core element: suspect (i.e., an individual/entity suspected of having committed a crime by authorities that want that suspect to be subjected to criminal proceedings). The frame also has the following two non-core elements: charges (i.e., offenses that the suspect is accused of committing) and degree (i.e., some gradable attribute and modifies the expected value of it).

As shown in Table 3, the keyword for the suspect element was AstraZeneca, and the keywords for the charges element were manslaughter and murder. In this context, manslaughter referred to an official accusation filed in Italian courts, while murder was a non-official offense aimed at the vaccine responsible for causing harm to vaccinated people with AstraZeneca.

Table 3. The Want Suspect Frame.

	Element	Keyword	Total Frequency	Relative Frequency per Million
	Suspect	AstraZeneca	33	65809
Want suspect	Charges	manslaughter	33	63775
		murder	1	45

As shown in Table 4, the final frame, the point of dispute frame, had one core element: question (i.e., an open proposition the answer to which is under dispute). It also had the following non-core elements: context (i.e., a state or event within which a question arises as a problem for a

group), descriptor (i.e., a characterization of a question), domain (i.e., the area of human experience that a question concerns), and group (i.e., people or organizations with different points of view on a question).

Many of the studied tweets contained questions, while others indicated issues with AstraZeneca. All tweets containing the question element had the keyword AstraZeneca for the context element. This indicated that the point of dispute frame was associated with the vaccine, as bad press has circulated. Furthermore, many people had questions and concerns about the AstraZeneca vaccine that they wanted to have addressed, and they expressed this desire via Twitter.

Table 4. The Point of Dispute Frame.

	Element	Keyword	Total Frequency	Relative Frequency per Million
Point of dispute	Question	question	3	60
		issue	2	53
	Context	AstraZeneca	33	63775

4.2. Results of the Twitter user analysis

In the graph depicted in Figure 1, the date of the tweets is on the x axis, and the number of tweets is on the y axis. Information about likes and retweets is also visible. Retweets are more prevalent in the figure than likes, indicating that users favored retweeting posts rather than liking the original tweet. Retweeting might be indicative of an amplification strategy, which Jamison et al. (2020) aligned with misinformation regarding vaccines on Twitter. Therefore, it is possible that the high concentration of retweets in the figure shows how misinformation about vaccines was circulated, and the use of an amplification strategy suggests that the retweeting was the result of Twitter bot activity associated with the hashtag (Broniatowski et al., 2018; Jamison et al., 2020). Meanwhile, the spike in likes on March 12–13, 2021 was most likely due to news about Denmark and Norway's investigations of blood clots and deaths related to the AstraZeneca vaccine (Mahase, 2021; Wise, 2021).
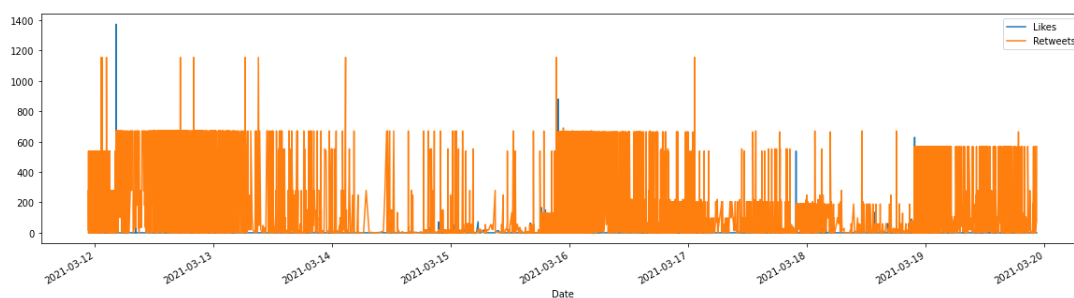
Figure 1. Likes and Retweets by Twitter Users.

Location information was determined based on the location details noted in the profiles of Twitter users. Location details were not available for more than 3,500 tweets in the dataset. However, nearly 250 tweets were posted by users in London. In addition, 100 tweets were from the UK generally, and 100 were from India. As shown in Figure 2, there was a similar

distribution of tweets from Brussels, Belgium; Paris, France; Ireland; Berlin, Germany; Nairobi, Kenya; Lagos, Nigeria; Europe; the United States; Australia; and undefined global locations.
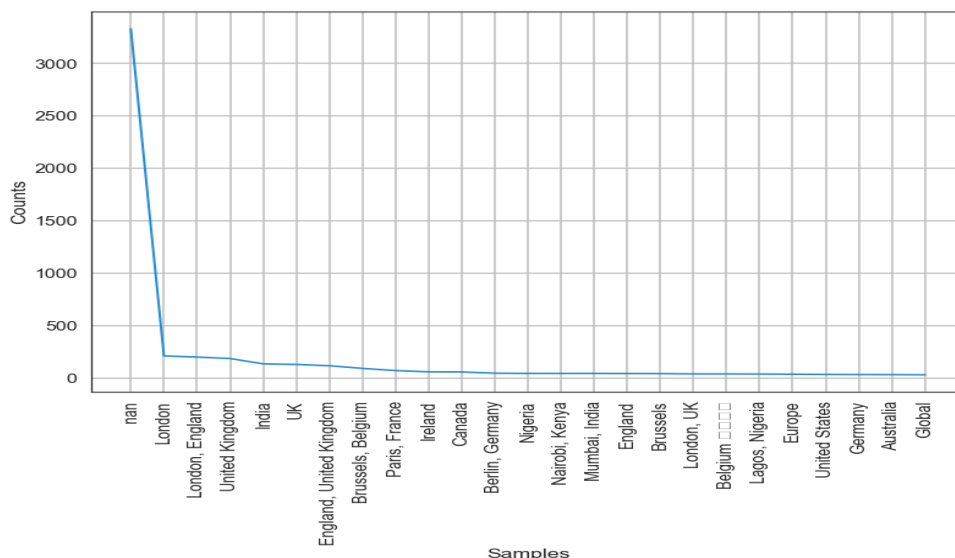

Figure 2. Tweet Locations Based on Twitter User Profiles.

Influential Twitter users were identified based on the frequency of their tweets. Figure 3 shows the distribution of the most active accounts in the dataset. For example, there were 43 tweets from the SickofRupert Twitter account, 40 from Tchat 4.0, 31 from SLOTE, 28 from #DestroyTheAadhaar TwiLightOFTheGODS, and 26 from Darren McCaffrey.
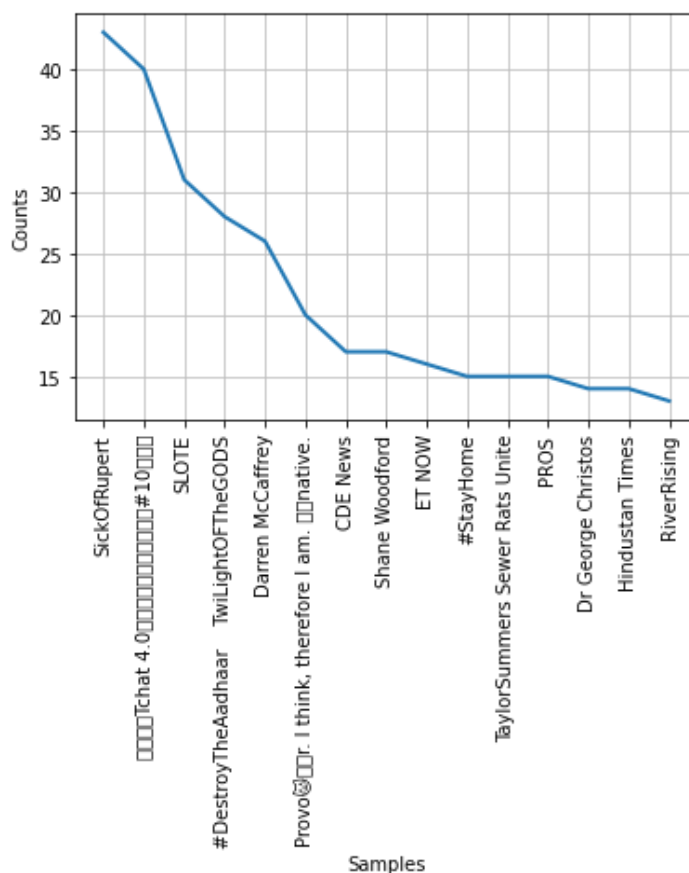
Figure 3. Most Influential Twitter Users in the Dataset.

So far no weird symptoms of the #AstraZeneca Jag I got yesterday, slightly tender arm, all good

Figure 4. The Most Liked Tweet in the Dataset.

The most retweeted tweet in the dataset, which is shown in Figure 5, had 2,260 retweets.

The controversial #AstraZeneca #vaccine, which #BillGates has heavily invested in, is being rejected by some countries over widespread concerns about side effects and efficacy. #TheDefender

ترجمة التغريدة

WHO Approves AstraZeneca Vaccine for Emergency Use, But Some Nations S...
The controversial vaccine, which Bill Gates has heavily invested in, is being rejected by some countries over widespread concerns about side effects and ...
🔗 childrenshealthdefense.org

Figure 5. The Most Retweeted Tweet in the Dataset.

I investigated the locations of Twitter users and extracted many European countries mentioned in the frame analysis; no tweets were found in the data from European users, as they were deleted. Only one tweet from Germany was found; it originated from a journalist's account and contained a positive view of the vaccine (Figure 6).

WHO still believes the benefits of the #AstraZeneca coronavirus vaccine outweigh current concerns about its safety. The agency recommends the continuation of its use.

WHO recommends that use of AstraZeneca jab continue
The World Health Organization still believes the benefits of the AstraZeneca COVID-19 outweigh concerns as the agency comes ...
🔗 dw.com
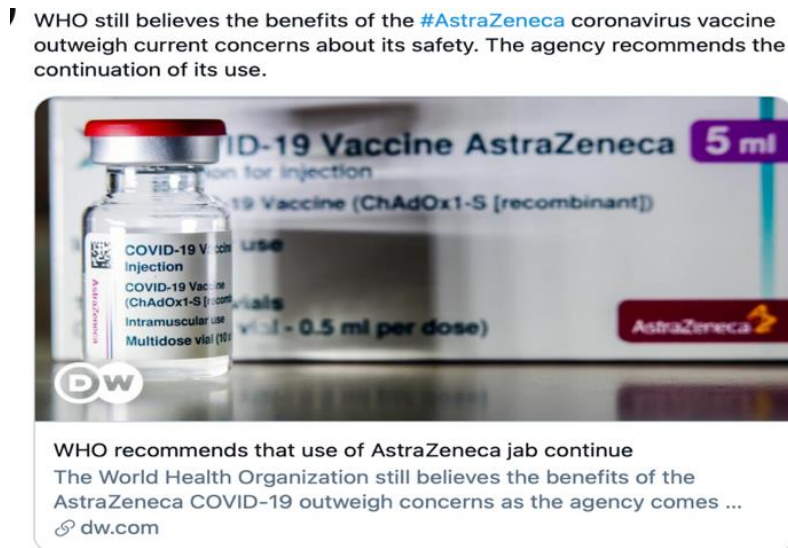
Figure 6. A Tweet from Germany.

4.3. Results of the vaccine frame and user engagement analysis

A sample from each frame was analyzed to draw inferences based on user engagement. The relationship between the frames and likes and retweets as well as the valence of each tweet was

considered. In some frames, personal tweets containing bad news received a higher level of engagement than news announcements.

4.3.1. The medical intervention frame.

Figure 7 contains examples of the failing medical intervention frame. Figure 7a shows a tweet, with an image of a health worker filling a syringe with the AstraZeneca vaccine, a news headline about side effects, and a link to the article. The tweet was descriptive and had a low engagement level, with one retweet and three likes. In contrast, Figure 7b shows a personal thread on the side effects of the AstraZeneca vaccine, detailing how recent news of side effects was not expected and should be worrying. Although the level of engagement was still low, with one retweet and six likes, the tweet had an alarmist depiction of the vaccine.

(a)   (b)

Figure 7. Examples of the Failing Medical Intervention Frame. (a) a news item showing a medical worker extracting the AstraZeneca vaccine into a syringe and (b) a personal tweet about the side effects of AstraZeneca.

Figure 8a shows a tweet with the familiar hand of a health worker extracting a vaccine and a link to a Daily Mail article describing the death of a Spanish teacher after receiving the AstraZeneca vaccine. This tweet, which can be considered a personal comment containing bad news, had more retweets (17) than likes (12). Interestingly, it also had two quote tweets, which allow other Twitter users to comment on the news. Figure 8b shows a personal tweet about side effects reported in Norway. This tweet had a higher level of engagement than the previous one, with 138 retweets, 25 quote tweets, and 180 likes. Overall, personal tweets with bad news in the failing medical intervention frame received a higher level of engagement from Twitter users than news announcements within the same frame.

(a) (b)

Figure 8. Examples of the Failing Medical Intervention Frame. (a) a news item about side effects reported in Spain with a picture of the hand of a health worker extracting a vaccine and (b) a personal tweet announcing reported side effects in Norway.

4.3.2. The shifting commitment frame

Figure 9 contains two representative tweets from the commitment frame.

(a) (b)

Figure 9. Examples of the Commitment Frame. (a) a viral news tweet about the decision of some European countries to suspend administration of the AstraZeneca vaccine and (b) a personal tweet announcing the user's decision not to get the AstraZeneca vaccine.

Figure 9a contains a viral tweet of a news item about how European countries decided to halt vaccinations with AstraZeneca until further notice. The tweet had a very high level of engagement from Twitter users, with close to 2,000 retweets, 226 quote tweets, and 4,484 likes. Figure 9b contains a personal tweet about the user's decision not to get the AstraZeneca vaccine. However, the use of the pronoun we and all caps formatting in the phrase "we do not consent" denoted a call to action. Unlike the medical intervention frame, within the commitment frame, news tweets, such as the one in Figure 9a, generated higher engagement

levels than personal tweets, such as the one in Figure 9b. In addition, in the commitment frame, personal tweets used more linguistic and stylistic features, such as hashtags, capital letters, plural pronouns, and negative nouns, to indicate negativity.

Figure 10 contains examples of two European countries with stances toward the AstraZeneca vaccine that were different than those of most European countries. As shown in Figure 10a, Poland demonstrated its commitment to using the vaccine regardless of side effect-related news, which was viewed as disinformation. The tweet had a higher level of engagement from Twitter users, with 423 retweets, 60 quote retweets, and 2,191 likes. Figure 10b illustrates how Greece was not affected by news about the side effects of the AstraZeneca vaccine and continued to use it. The tweet had a medium level of engagement, with 14 retweets and 43 likes.

(a)   (b)

Figure 10. Examples of the Commitment Frame. (a) a personal tweet about Poland's decision not to suspend use of the AstraZeneca vaccine and (b) a tweet about Greece's continued use of the AstraZeneca vaccine.
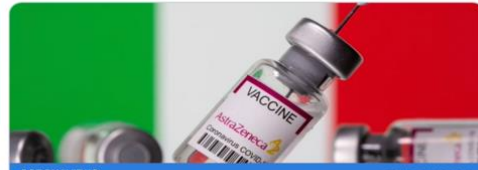
4.3.3. The want suspect frame

Figure 11 contains two examples of the want suspect frame. Figure 11a shows a personal tweet depicting AstraZeneca negatively through capitalization; emojis; and words, such as guilty and crime. The valence of the tweet was very negative and high pitched. Figure 11b shows a tweet describing the legal consequences following the death of a teacher in Italy. In both examples, the vaccine was designated as an agent that was held accountable for possible deaths. The tweet in Figure 11a had a lower level of engagement than the one in Figure 11b, possibly because the former was a personal accusation, while the latter involved a serious legal action.

(a)   (b)

Figure 11. Examples of the Want Suspect Frame. (a) a personal accusation about AstraZeneca and (b) a legal accusation about the AstraZeneca vaccine from a Twitter news feed account.

4.3.4. The point of dispute frame

Regarding the point of dispute frame, there was little engagement with the tweets shown in Figure 12, which were published in March 2021.

(a)   (b)

Figure 12. Examples of the Point of Dispute Frame. (a) an article about the safety of the AstraZeneca vaccine with a comment from one Twitter user and (b) the same article with a comment from another user.

5. **Discussion**

It is necessary to understand how messages about a novel vaccine influence the public's decision to get vaccinated (Mheidly & Fares, 2020). This is especially true because people often use social media to learn about recent health-related news and information. The present study has underlined the importance of investigating how vaccines are framed in social media and shared insights on the relationships between different frames and user engagement.

The study methodology involved frame semantics, a quantitative analysis of Twitter users, and a qualitative analysis of the relationship between the frames found in the dataset and user engagement. This approach had many advantages. First, it considered the nature of social media data, which is complex and multidimensional. Applying different analysis methods yielded different findings that complemented the overall conclusion of the analyses. Second, it informed the findings by providing a snapshot of how the public has framed AstraZeneca in a negative way. Third, it summarized how health misinformation has been articulated and disseminated between Twitter users during one of the major health crises in human history. Fourth, frame semantics contributed to the study by identifying frames associated with the vaccine and could advance other research within the health communication framework. Fifth, the frame analysis of keywords provided a theoretical basis for the future advancement of a sound framework for describing frames using two or more lexical items, such as bigrams or trigrams. Sixth, knowing how health messages are framed requires researchers to know more about who produces and circulates these messages, especially when dealing with misinformation. Seventh, discerning the relationships between frames and likes, retweets, and the sentiments of tweets benefitted the overall analysis of each frame. As frames contained hierarchal systems (Lakoff, 2010), the four frames found in the dataset were governed by one system: vaccination framing. Furthermore, there were three sub-systems that invoked all of the frames: vaccination politics (the vaccine), with its reported side effects; people's reactions to the AstraZeneca vaccine (the citizens); and governments' reactions to the AstraZeneca vaccine (the government). Vaccination politics came into play in the failing medical intervention frame, and 19 keywords in the side effect element described the vaccine as causing life-threating side effects. Other elements, such as the result element, described mild symptoms after vaccination. In the extent element, the vaccine was described as risk-free or safe, regardless of the side effects. However, the extent element seemed to contribute to the overall framing of the vaccine. The depiction of AstraZeneca within the failing medical intervention frame was invoked because other frames and sub-systems about vaccinations and people's historical reluctance to get vaccinated were invoked as well.

Governments' reactions to the AstraZeneca vaccine were invoked in the commitment frame; negative views about the AstraZeneca vaccine led to commitment shifts by some countries. The determining factor was how each speaker seemed to favor one message over another. For example, India, Taiwan, and the HSE seemed to favor continuing the administration of the vaccine, while some European countries seemed to favor halting the use of the vaccine. The negativity of the framing increased when analyzing the manner element; very negative words, such as deadly, greatly contributed to the distrust of AstraZeneca by some European countries. This frame led countries to take action to either stop or continue using the AstraZeneca vaccine.

People's reactions to news about the AstraZeneca vaccine invoked the want suspect and point of dispute frames. In the want suspect frame, the public expressed extremely negative views of the vaccine in two ways: the circulation of news about a manslaughter case against AstraZeneca

in Italian courts and a description of how taking AstraZeneca is associated with murder. The suspect in the frame was the vaccine. In the point of dispute frame, the AstraZeneca vaccine prompted many questions and unresolved issues. This finding is in line with other frame-related studies that demonstrate how one cannot underestimate the power of the public's reaction, and how it can affect media reporting and government response (Entman, 1993).

Regarding Twitter user analysis, spikes in retweets need to be analyzed according to the context of the situation (Martin & English, 1992). The present study revealed an increase in tweeting activity, which was most likely due to news reports from Denmark and Norway concerning serious side effects about blood clots caused by the AstraZeneca vaccine (Mahase, 2021; Wise, 2021). Moreover, relationships between frames and Twitter user engagement were identified by studying tweeting practices and conducting a linguistic analysis of examples of each frame. In some frames, personal tweets had higher engagement levels than tweets about news reports; in others, the opposite relationship was found.

6. Conclusion

The present study aimed to (a) examine how AstraZeneca has been framed on social media, (b) characterize Twitter users who have engaged in the distribution of health-related information about the AstraZeneca vaccine, and (3) demonstrate the impact of various frames on user engagement. To accomplish this, a medium-sized dataset was gathered from Twitter and investigated using frame analysis and quantitative analysis to examine demographics and user engagement, and qualitative analysis. Within the overarching vaccination framing system, the following three subsystems were identified: the vaccine, the citizens, and the government. Furthermore, the vaccination framing system contained the failing medical intervention, the shifting commitment, the want suspect, and the point of dispute frames. These frames, which cast the vaccine in a negative manner, have implications for health professionals, policies, and practices. Additionally, Twitter user analysis demonstrated users' levels of engagement and their role in circulating health misinformation, which could result in an increase in vaccine hesitancy rates.

The present study can shape future research through its insights on the public's negative perception of the AstraZeneca vaccine. This study has limitations in terms of the small size and narrow date range of the dataset. It would be fascinating for future research to examine data spanning a longer period in order to observe how the framing of AstraZeneca evolves over time.

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