

Healthcare Misinformation in Online Social Platform

Yu Duan
University of California, Irvine
Irvine, CA, United States
duany12@uci.edu

Antriksh Ganjoo
University of California, Irvine
Irvine, United States
ganjooa@uci.edu

Kenneth Pat
University of California, Irvine
Irvine, CA, United States
patk@uci.edu

Abstract

This is the final project report for INF251 CSCW 2024 Spring.

Keywords: Misinformation, Healthcare, Social Platforms

ACM Reference Format:

Yu Duan, Antriksh Ganjoo, and Kenneth Pat. 2024. Healthcare Misinformation in Online Social Platform. In *Proceedings of (Class Report)*, 9 pages.

1 Introduction & Motivation

Misinformation on online social media is a significant research topic due to its profound impact on various societal aspects, such as public health, democracy, and social well-being. It spans across multiple subfields, including health, politics, fake news, technology, and economics. It is so prevalent that oftentimes people are unable to recognize it. More importantly, misinformation may bring long-term effects to a person's behavior in real life and mental health conditions and may cause stress and anxiety. The outbreak of COVID-19 in 2020 has heightened awareness about health information, with social media becoming a primary source for collecting information and influencing user behavior. The persistent existence of misinformation in online social media shapes users' daily behavior, potentially leading to negative and irreversible social effects on individuals, even the whole society.

Therefore, our project aims to 1. deconstruct and measure the misinformation dissemination in online social platforms, 2. understand and summarize key factors and features influencing healthcare misinformation spread from the content creator, platform, and user perspectives, and 3. providing suggestions to practical technology solutions, also to users.

2 Contributions & RQs

For contributions, we explore healthcare misinformation in online social platforms from three different lenses broadly and deeply, which also align with the information propagation pipeline in the digital world. Below are the three major contributions:

1. From the content creators' lens, we analyzed the current situation of healthcare fake news spreading across

platforms and within a popular platform (e.g. COVID-related information on Twitter).

2. From the platforms' lens, we explored top companies' official documentation and transparency disclosures about their fact-checking mechanism and policies (e.g. Twitter, Meta).
3. From the users' lens, we conducted a survey to understand the users' perception of healthcare misinformation spreading online.

In the whole healthcare misinformation pipeline, our project is centered on three research questions (RQs):

- *RQ1: How do observations of fake news differ from real news across various digital platforms, particularly in the context of healthcare misinformation?*
- *RQ2: What methods and strategies are social media platforms using to detect and prevent the spread of healthcare misinformation?*
- *RQ3: How does healthcare misinformation on social media platforms impact user behavior, and what measures have been implemented to combat it?*

3 Related Work

The surge in misinformation, disinformation, and fake news, particularly during times of crises such as pandemics, has garnered considerable attention in academic literature and research. Previous surveys and literature reviews have emphasized its potential to induce panic among citizens and undermine trust in governmental authorities and policymakers, with potentially severe ramifications. This misinformation can severely impact various aspects of life, including public health, politics, climate change, and the economy. For example, during the COVID-19 pandemic, widespread misinformation caused psychological distress and led to the adoption of inappropriate protective measures [1] (Dong et al., 2020; Pian, Chi, & Ma, 2021). In politics, misinformation not only affects electoral behavior but also increases political division and reduces trust in government [5] (Garrett, 2019; Lazer et al., 2018). Misinformation regarding climate change has misled the public and impeded their response to mitigation policies [4] (Cook, Ellerton, & Kinkead, 2018; Treen et al., 2020). Economic misinformation can damage corporate reputations and influence consumer purchasing decisions (Berthon & Pitt, 2018; Di Domenico, Sit, Ishizaka, & Nunan, 2021). Given the widespread and harmful effects of misinformation on social media, a thorough and systematic review of the literature is essential to understand the factors

contributing to its spread and to develop strategies to counter it. For instance, [2] Matin documented cases in early 2020 where misinformation circulated on social media platforms led numerous Iranian citizens to consume large quantities of methanol, believing it would protect them from the virus. This resulted in over 2000 hospital admissions across the country due to methanol poisoning, leading to 264 fatalities. [3] Similarly, Naeem et al. conducted a study analyzing 1225 instances of fake news stories between January 2020 and April 2020, revealing that social media platforms were accountable for disseminating 50% of the false information. The study identified three primary categories of coronavirus misinformation: false claims, encompassing inaccurate information about COVID-19 transmission modes and purported cures (such as the belief in methanol consumption as a cure), propagation of conspiracy theories fueled by statements from world leaders and public figures regarding the virus's origin (e.g., the claim of 5G towers spreading the virus), and the promotion of pseudoscientific remedies and treatments purportedly capable of preventing or curing COVID-19 infections (e.g., claims advocating steam inhalation as a cure for COVID-19).

4 Experiments & Results

4.1 Overview

For information spreading on online social platforms, there are mainly three roles in this process: content creators, platforms, and users (see Figure 1). Content creators, individuals, or organizations who generate and share content online, play an important role in disseminating information. However, with the ease of content creation and sharing, there's a potential risk of misinformation being unintentionally or deliberately propagated. Platforms, the digital spaces where users interact and share content, serve as pipes for dissemination. While platforms strive to moderate content, the large volume makes it challenging to control misinformation effectively. Users, the individuals consuming and engaging with content on these platforms, are susceptible to misinformation due to the multiple sources and the inherent challenge of distinguishing reliable information from falsehoods. As a result, mitigating misinformation spreading on online platforms necessitates a multifaceted approach involving content creators, platforms, and users themselves.

So, our work starts from the observation of three role players in misinformation games, content creators, platforms, and users. Then, we summarize the findings and implications from each part. At last, we give more insightful suggestions across three role players to mitigate the healthcare misinformation propagation on online social platforms.

4.2 Content Creator

In the content creator section, we show how misinformation propagates in both macro-scope and micro-scope. We play

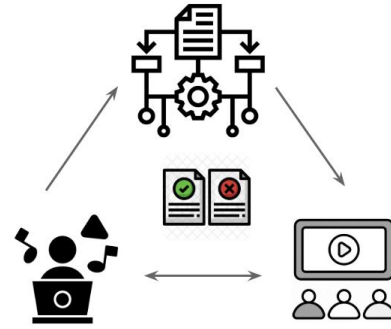


Figure 1. Overview: Roles involving in information spreading on social platform, which include content creators, platforms, users. Gray arrows show the information flow between different roles.

with two datasets, Politifact and Twitter-covid datasets. The first is from a popular fact-check website that lists fake news from different sources and related to different topics, the analysis results provide us macro-scope understanding of misinformation propagation (see section 4.2.1). The second dataset is a Twitter-covid dataset, which contains tweets and articles related to COVID-19 fake news on the Twitter platform, it serves as a case study for us to explore more detailed findings for healthcare fake news spreading while considering network topology and large volume of text.

Dataset 1: From a popular fact-check website (politifact.com), the fake news comes from various sources including platforms (Instagram, Facebook, Twitter) and celebrities, the time span we considered was from 2013 to 2020. Features include fake news headlines, URLs, sources, stated dates, checked dates, and fake news labels. We change the 9-category labels into binary labels.

Dataset 2: It is crawled from the Twitter website, which is available on Kaggle. It contains four types of subsets: fake news, real news, claim fake, and claim real. Besides, with each subset, it includes three major information sources: tweets, replies, and long articles (reachable when the user clicks on the hyperlink in tweets). Our project focuses on the comparison between fake news and real news, as well as fake news networks and content.

4.2.1 Misinformation propagation over time. Firstly, we analyze the Politifact dataset from a time perspective. Figure 5 shows how the fake news amount and fake news rate change each year and as the year increases. Fake news rate means the percent of fake news in the fact-check pool in a certain year. We have the following observations: 1) The amount of fake news is growing every year. 2) Besides, the fake news rate is increasing every year, and in 2020 the fake news rate reached its peak. The longitudinal analysis result shows people are exposed to more and more news every year,

and the news has a high possibility of being fake news. So it's with great importance to check which source contributes more to the fake news propagation.

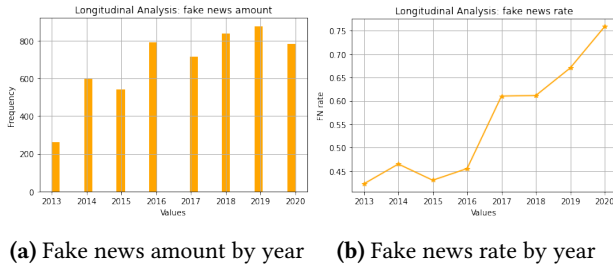


Figure 2. Longitudinal Analysis

4.2.2 Misinformation propagation across space. In this section, we analyze the Politifact dataset from a space perspective, narrowing down the news source to the top 3 online social platforms that have more fake news: Instagram, Twitter, and Facebook (except for online social platforms, the news source also can be celebrities, etc.). In the comparative analysis, we use three metrics to evaluate the fake news propagation situation in different platforms, the results are shown in Table 1. Three metrics include fake news amount, fake news rate, and fact check duration. When the fake news amount is larger, the fake news rate is higher, average fact-check duration is longer, which means the fake news propagation situation in this platform is worse.

Platform	FN Amount	FN Rate	FC duration(days)
Instagram	21	100%	5.9
Twitter	21	77.8%	4.0
Facebook	580	88.5%	10.3

Table 1. Comparative Analysis: different platforms

We have three observations based on the comparative analysis results for platforms: 1) The fake news amount in Facebook is much more than on Instagram and Twitter since there are many more users on Facebook than on the other two social platforms. 2) All three platforms' fake news rates are high, around or above 80% within the PolitiFact fact-check pool. Besides, The fake news rate on Instagram is more significant(100%) compared with the other two platforms, which means the fake news situation on Instagram is worse. 3)The fact-check durations for three different platforms range from 4 to 10 days, it is a long duration which can cause a negative effect on the audience. Besides, we also show more details for fact-check durations(see Figure 3), the situation for Instagram and Twitter is worse and Facebook is the worst, the largest value for fact-check even can reach more than 200 days. All three fake news metrics results show the misinformation situation is worse across platforms, which

also raises the awareness to design a better misinformation detection mechanism on the platform's side.

4.2.3 Case Study: Covid-19 in Twitter. During COVID-19, the healthcare misinformation is more severe than before, so it provides a case with more obvious properties. In this section, we dive deep to analyze the present situation for healthcare misinformation using dataset 2(Twitter-Covid Dataset). Firstly, using the topological analysis, we compare the fake news network and the real news network. Then we consider more broadly and deeply content, leveraging the work frequency to build the bridge between fake news and sentiment, which helps us to get more insightful findings.

Topological Analysis

In this part, we explore the dataset from a topological angle, using tweets and replies to build a network. Then based on the network, we summarize the degree distribution and the boundary point(breadth and depth), which correspond to the popularity and depth of the news topic(see Table 2). More detailedly, the right extreme point represents the news popularity, which reflects on the largest node degree in the network and answers "how many replies" for a tweet; more replies mean higher popularity. Besides, the left extreme point represents the number of one-degree nodes, in other words, it's a signal for both conversation depth and breadth, which also reflect the tweet popularity.

Based on the results in Table 2, we have the following observations. 1) In the numbers of news/tweets/replies(last 3 rows), we can conclude real news discussion dominates the conversation on Twitter. And generally, more tweets will attract more replies. 2) From the degree distribution extreme points of the tweet-reply network(first 2 rows), we can see real or claim real news involves deeper and broader conversation. The two observations provide us with insights about what are the key characteristics to show the dominance of the tweets conversation, which will contribute to misinformation mitigation and detection.

Measures	Fake	Real	Claim F	Claim R
Left	(1,7927)	(1,114381)	(1,538)	(1,8809)
Right	(191,2)	(247,1)	(17,1)	(199,1)
News No.	146	2532	19	166
Tweets No.	10439	137607	460	7379
Replies No.	7373	111910	545	9436

Table 2. Topological Analysis: fake vs. real news

Content Analysis

Even though the topological analysis gives us insightful observations, however, it's still at a shallow level without touching the enriched content to analyze the healthcare misinformation. Besides, sentiment also plays a strong signal in many text analysis tasks. So in this part, we use word frequency to serve as the bridge to text analysis and sentiment,

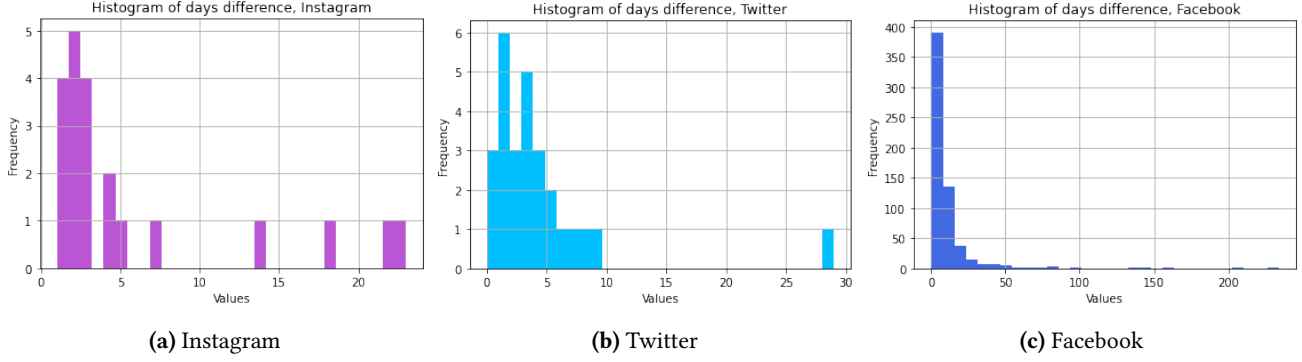


Figure 3. Comparative Analysis: days difference

mixing with the proposed content layer-wise model by considering content type and confidence level, to show the correlation between fake/real news and negative/neutral/positive emotion.

At first, we check the content type in the Covid-Twitter dataset, which is a combination of posts and articles. In fake news, post type dominates the content type with percent 76.1%(in total 854 items). However, in real news, article type dominates the content type with a percentage of 98.8%(in total 3607 items). Content type ratios in fake/real news give us enlightenment to design the layer-wise content analysis model since each content layer will provide different content depth. Besides, we should also put a higher weight on article type, since from the content type findings article type provides content with a higher probability close to real news.

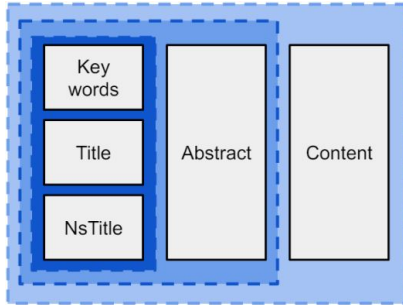


Figure 4. Layer-wise Content Analysis Model

Then we design the layerwise content analysis model(LCAM, see Figure 4) and implement it in dataset 2(see results in Appendix B). In the proposed layerwise content analysis model, there are 3 levels in total(L1-L3). L1 contains features including keywords, titles, and news titles, which only show the high-level information for the post/article content. Then L2 includes not only L1 but also the abstract, which provides more descriptions for content. At last, L3 contains L2 with article content, which is a deeper content reach also with more trusted or truthful content, where we put more weight when analyzing the content.

At last, we implement LCAM in the Covid-Twitter dataset(see results in Appendix B). We present the results using taxonomy [News Fake/Real \times L1/L2/L3]. In each cell content, we rank the words by decreasing frequency order and eliminate the no-meaning words. Then we classify the words in each with the emotional state(negative/neutral/positive) and get the results Figure/Table 7. From the table, we have the following observations for similarities and differences. For similarities: 1) In both fake/real news, there always are more neutral and positive words when the content level reaches deeper. 2) More content-wise words, less emotion/attitude-related words. For differences: 3) When in the same content layer depth, fake news has more negative emotion words, especially in the shallow layer. It implies the correlation between fake/real and negative/positive emotions.

To sum up, first, we analyzed the misinformation situation across content platforms with several fake news metrics. Then we did a case study for Twitter-Covid and explored the enriched dataset from topology and content. To analyze the content, we leverage high-frequency words to build the bridge between content and sentiment. All the above analyses give us a lot of insights into the present content creator behavior regarding healthcare misinformation in digital platforms.

4.3 Platform

4.3.1 How platforms deal with misinformation in general? This excerpt highlights the multi-faceted approach employed by social media platforms like **Facebook, Instagram, and Threads** to identify misinformation. Through sophisticated technology, they analyze various signals such as user engagement and the speed of content dissemination. Additionally, user reports and comments expressing skepticism contribute to the identification process. Fact-checkers play a crucial role in independently flagging content for review. To mitigate the spread of potentially false information, platforms may temporarily reduce the visibility of such content in users' feeds until it undergoes review. This proactive approach aims to curb the impact of misinformation and

maintain the integrity of the platform's information ecosystem.

Twitter is one of the world's most popular social media platforms, with over 330 million monthly active users around the globe. Like other social media platforms, Twitter has been heavily scrutinized for its role in facilitating the spread of misinformation and disinformation, particularly related to COVID-19. In response, Twitter launched a range of initiatives and efforts, which are documented, alongside regular updates, in an online repository hosted on the company's website. In January 2020, the company shared that it expanded its dedicated search prompt feature to ensure content from authoritative sources appears at the top of search results related to COVID-19. According to the company, this feature is now available in approximately 70 countries, and the company has partnered with national public health agencies, the WHO, and local partners to ensure users have access to verified information. Twitter has also prevented its auto-suggest feature from directing users to misleading sources when they enter COVID-19-related search terms. This change was part of an expansion of the company's "Know the Facts" prompt, which was established in 2019 to provide users with access to clear, legitimate information related to immunizations and vaccinations.

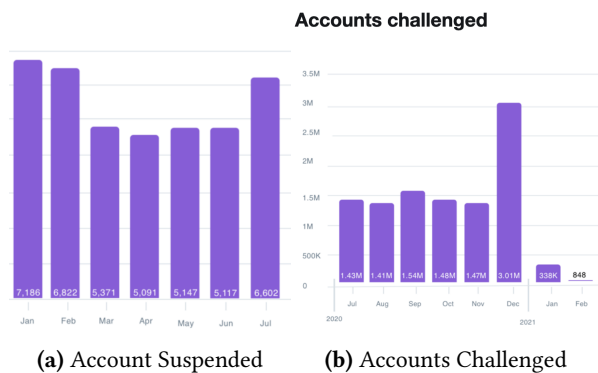


Figure 5. Twitter Misinformation Analysis

4.3.2 Identifying misinformation. This highlights the multi-faceted approach employed by social media platforms like Facebook, Instagram, and Threads to identify misinformation. Through sophisticated technology, they analyze various signals such as user engagement and the speed of content dissemination. Additionally, user reports and comments expressing skepticism contribute to the identification process. Fact-checkers play a crucial role in independently flagging content for review. To mitigate the spread of potentially false information, platforms may temporarily reduce the visibility of such content in users' feeds until it undergoes review. This proactive approach aims to curb the impact of misinformation and maintain the integrity of the platform's information ecosystem. When Meta identifies content that

has been reviewed by fact-checkers, we add a notice to provide additional context for readers. Content rated as Satire or True won't be labeled, but a fact-check article will be attached to the post on Facebook. We also alert users before they attempt to share this content or if they have shared it previously. Meta uses technology to detect content that is the same or nearly the same as content rated by fact-checkers and add notices to such content as well. Generally, Meta does not add notices to content with similar claims rated by fact-checkers if the content is not identical. This is because minor differences in phrasing can affect the accuracy of the claim.

According to Twitter, the company uses its internal tools to proactively monitor content on the platform and to make sure that the company is not amplifying content by appending labels to it. Twitter is also working with its trusted partners to flag content that could yield harmful offline consequences and will be prioritizing the review and labeling of content that could result in increased exposure to or transmission of the virus.

4.3.3 Ensuring fewer people see misinformation. Once a fact-checker rates a piece of content as False, Altered, or Partly False, or Meta detects it as near identical, it may receive reduced distribution on Facebook, Instagram, and Threads. The team at Meta dramatically reduced the distribution of False and Altered posts and reduced the distribution of Partly False to a lesser extent. For Missing Context, Meta focuses on surfacing more information from fact-checkers. Meta does not suggest content to users once it is rated by a fact-checker, which significantly reduces the number of people who see it.

They also reject ads with content that has been rated by fact-checkers as False, Altered, Partly False, or Missing Context and we do not recommend this content.

4.3.4 Taking action against repeat offenders. Pages, Groups, Profiles, websites, and Instagram accounts that repeatedly share content rated False or Altered are put under some restrictions for a given time period. This includes removing them from the recommendations shown to people, reducing their distribution, removing their ability to monetize and advertise, and removing their ability to register as a news Page.

4.4 User Perception

User experience remains an important factor on social media platforms. A platform with a good user experience and a set of comprehensive measures to tackle misinformation will likely attract more new users. In the past weeks, we have learned about the danger of users unknowingly receiving and spreading misinformation and fake news, as well as how content creators use tactics to create an "echo chamber" effect across one or multiple social media platforms.

In the past few weeks, we conducted a survey in the form of questionnaires (see Appendix A for details) with questions that are closely related to the study of analyzing user experience from a user's point of view. The survey was created and results were collected on Google Forms and contains 12 questions. Questions 1 to 10 are ranked-based, quantitative multiple-choice questions, whereas questions 11 and 12 are optional and qualitative open-ended questions. Although we only received 16 responses, it still gives a picture and provides some valuable information regarding how we as users perceive the current situation of misinformation. Participants are given five choices for each question, ranging from: strongly disagree, disagree, neutral, agree, and strongly agree.

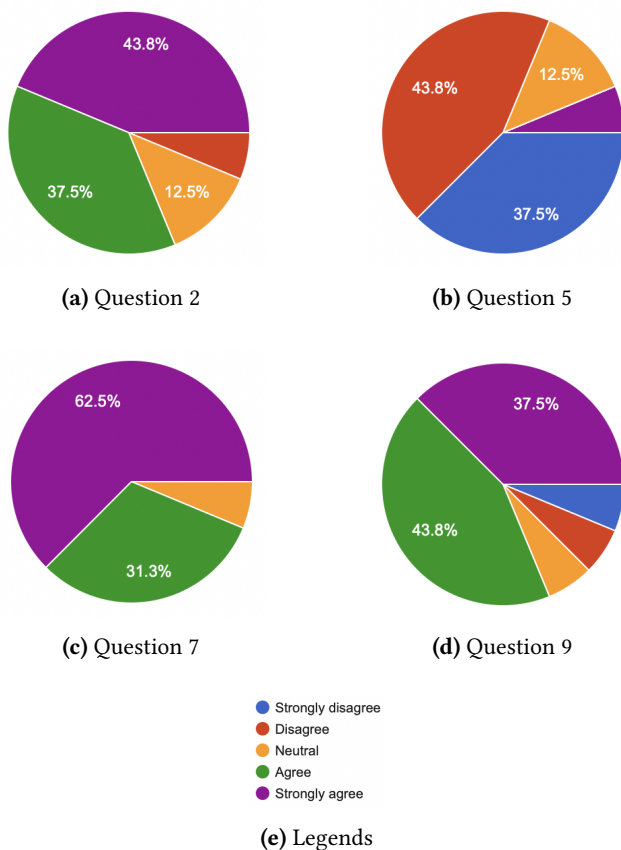


Figure 6. Survey Results

5 Implications

5.1 Content Creator

We have a lot of findings in the content creator experiment part. Firstly, fake news amount & fake news rate are growing every year, which shows the misinformation situation across time and space gets worse and worse. For the top 3 platforms' fake news, the fake news rate is high and the fact check duration is long, which asks for a better solution for fake

news spreading in platforms. Besides, in the Covid-Twitter case study, we show a lot of different behaviors for fake news and real news, which will serve as strong signals to detect fake news.

Then from the content creator's angle, there are also many important suggestions to mitigate the healthcare misinformation spreading. We encourage content creators to always verify information from multiple reputable sources and use fact-checking tools to ensure accuracy. Also to cite authoritative sources and avoid dubious ones, maintaining transparency about your methods and sources is very crucial. Besides, content creators have the responsibility to correct any mistakes and focus on accurate, balanced, and well-researched information. Lastly, to foster a community that values truth, encouraging reporting of misinformation and respectful, fact-based discussions also help to mitigate the healthcare information.

5.2 Platform

After a detailed study of these online platforms, we saw that the Fact-checkers play a crucial role in maintaining the integrity of public content on platforms like Facebook, Instagram, and Threads. They meticulously review and rate a variety of posts, which encompass ads, articles, photos, videos, Reels, audio, and text-only content. The primary objective is to identify and address misinformation that could mislead the public. However, in the spirit of free expression, fact-checkers generally refrain from interfering with certain types of content. This includes personal opinions, debates, and content that is clearly satirical or humorous. They also typically avoid getting involved in business disputes.

The primary targets of fact-checkers are viral false information, hoaxes without any factual basis, and provably false claims that are timely, trending, and consequential. Viral false information refers to misleading content that has gained significant traction and visibility. Hoaxes are deliberately fabricated stories or claims that lack any foundation in reality. Provably false claims are assertions that can be definitively proven wrong through evidence and fact-checking. These types of misinformation are particularly prioritized because of their potential to cause widespread misunderstanding or harm.

By focusing on these areas, fact-checkers aim to reduce the spread of false information and ensure that the public has access to accurate and reliable information, thereby supporting informed decision-making and public discourse.

5.3 User Perception

The results from the user experience survey revealed several important findings on user perception from the participants. First, we can see that most participants have encountered misinformation (question 2). More importantly, it showed that as time elapses, users have developed their own mechanism to detect misinformation while browsing social media.

They have the ability to determine whether they think a post contains genuine information, based on their past experience and own judgment. Next, although major social media platforms typically have a web page dedicated to stating and presenting company policies related to transparency, most participants do not seem to buy it. Users simply do not trust tech companies on this matter and are doubtful about whether they are being arbitrary when it comes to handling misinformation. Finally, questions 7 and 9 showed that most participants know about the potential impact of misinformation and the subsequent consequences it might cause to society. Also, they believe that tech companies who are running these platforms should be held accountable for the spread of misinformation on their networks. It showed that users desire clear lines of accountability to be applied to tech companies, since under most circumstances, when fake news causes damage (such as defamation) to the image of a person, only the author/content creator of a post is liable, whereas the tech company can usually get away without any liability.

5.4 Misinformation Life Cycle in Digital Platform

From the content creator's perspective, there are several important recommendations to mitigate the spread of healthcare misinformation. Content creators should always verify information from multiple reputable sources and use fact-checking tools to ensure accuracy. Citing authoritative sources and avoiding dubious ones, as well as maintaining transparency about methods and sources, is crucial. Content creators also have a responsibility to correct any mistakes and focus on providing accurate, balanced, and well-researched information. Lastly, fostering a community that values truth, encouraging the reporting of misinformation, and promoting respectful, fact-based discussions can help mitigate the spread of healthcare misinformation.

From the platforms' part, platforms should strengthen their fact-checking mechanism and should enhance their ML models based on inputs received from authorities, also platforms should look into the accounts of people who are spreading misinformation and take strict action against them. From the user survey part, we observed that a lot of people have been the victim of misinformation online, and a lot of people have also seen a rise in the spread of misinformation globally. According to us, the best thing that users can do to stop the spread of misinformation is to verify the credibility of the sources and articles that they follow on these social media platforms and report or block these sources if found mischievous.

6 Discussion

6.1 Limitations

Our study focused primarily on misinformation related to healthcare. However, our survey does not contain questions

that are dedicated to health-related topics, such as the COVID-19 pandemic. This may create a generalized point of view from the users, rather than a detailed perspective regarding misinformation on health. Additionally, when we were researching information online for this project, we examined mostly social media **platforms**, without covering topics in instant messaging apps such as WhatsApp, Telegram, or Signal. This may limit the overall comprehensiveness of our study since various instant messaging apps allow users to create channels to broadcast messages to all viewers, which makes them function like social media platforms in principle.

6.2 Future Work

If we want to expand our work in the future, we should gather more information about misinformation related to healthcare on instant messaging apps. This would allow prospective scholars or researchers who want to replicate our study to have a good comparison between these two groups (i.e. social media platforms vs. instant messaging apps). Also, we could examine the relationship between the spread of misinformation on social media vs. other types of media, such as television or newspapers. Although TV stations and newspapers tend to provide more genuine information since they often have editorial boards to fact-check topics before releasing them to the public, there were occasions about misinformation was spread from these media. By looking into the relationship between traditional media vs. social media platforms, we can gain a deeper understanding of misinformation from a structural perspective, as well as its societal impact.

7 Conclusion

In conclusion, misinformation related to healthcare has a significant impact on our society. It is created and spread by content creators with malicious purposes on popular platforms to attract viewers and achieve a specific set of goals. As time passes by, there will only be more users on popular social media platforms, which results in an increasing amount of fake news. Often, fake news is created and spread to attract its targeted audience. With the sharp increase in misinformation and different political arguments during the COVID-19 pandemic further complicating the issue, content moderation and detection on social media platforms become the top priorities of tech companies. By understanding the impact of healthcare misinformation on social media platforms and analyzing the feedback from user perception, our study revealed a huge distrust in handling misinformation by tech companies, even though a large number of them have web pages dedicated to the explanation of transparency. Lastly, users from the general public would like to see tech companies be held more accountable and with more liabilities when handling misinformation on their platforms.

References

- [1] Wei Dong, Jinhu Tao, Xiaolin Xia, Lin Ye, Hanli Xu, Peiye Jiang, and Yangyang Liu. 2020. Public emotions and rumors spread during the COVID-19 epidemic in China: web-based correlation study. *Journal of Medical Internet Research* 22, 11 (2020), e21933.
- [2] Alireza Azeri Matin. 2023. Media Dependency and Public Skepticism in Authoritarian States: Discursive Trends in Disseminating Information about COVID-19 in Iran. *Journal of Information Science Theory & Practice (JISaP)* 11, 4 (2023).
- [3] Mingke Rao. 2021. *How did fake news affect health communication during the COVID-19 pandemic in China?* Ph. D. Dissertation. University of Leeds.
- [4] Kathie M d'I Treen, Hywel TP Williams, and Saffron J O'Neill. 2020. Online misinformation about climate change. *Wiley Interdisciplinary Reviews: Climate Change* 11, 5 (2020), e665.
- [5] Brian E Weeks and R Kelly Garrett. 2019. Emotional characteristics of social media and political misperceptions. *Journalism and truth in an age of social media* (2019), 236–250.

	NewsFake	NewsReal
L1	negative: not, against neutral: coronavirus, covid-19, vaccine, pandemic, masks, president, virus, media positive: new, shared	negative: denied neutral: coronavirus, covid-19, disease, during, testing, pandemic, schools, people, face positive: access, care, prevention
L2	negative: not, against neutral: coronavirus, covid-19, vaccine, president, pandemic, masks, bill, video, virus, positive: health, novel,	negative: denied, neutral: coronavirus, covid-19, disease, infection positive: health, new, novel, guidance,
L3	neutral: coronavirus, covid-19, facebook, people, president, vaccine, pandemic, world positive: health, new,	negative: - neutral: coronavirus, covid-19, people, disease, pandemic positive: health, protect, cdc, information, care

Figure 7. Layer-wise Content Analysis Results

A User Study: Survey on User Experience

Question 1: Does the social media platform you use the most provide reporting features for users to report misinformation and fake news? If so, do you think these features are effective?

Question 2: Do you frequently encounter posts or advertisements on social media that you suspect to contain false information or misleading?

Question 3: After you submitted a report on misinformation, do you feel that the social media platform responds timely back to you?

Question 4: Do you feel that social media platforms are effectively removing and labeling misinformation after it has been reported or fact-checked by the platforms themselves?

Question 5: Do you feel that social media platforms are being transparent on their actions in fighting against misinformation and fake news?

Question 6: How confident are you in catching and identifying misinformation on social media platforms?

Question 7: Do you think that misinformation on social media platforms has a strong and significant impact in society?

Question 8: Are you satisfied with the educational resources provided by social media companies to help users identify misinformation?

Question 9: Do you feel that social media companies should be held accountable for the spread of misinformation on their networks, as well as their subsequent consequences from the misinformation?

Question 10: Do you feel that the efforts to combat misinformation by social media platforms have contributed to improvements in user experience?

Question 11 (optional, qualitative): What do you think are the main reasons that triggered the rapid spread of misinformation or fake news? (You can talk about it on one specific topic or on the overall situation.)

Question 12 (optional, qualitative): What type of measures do you think the social media platforms could implement in order to effectively combat the spread of misinformation or fake news?

B Layerwise Content Analysis Result

In Figure 7, it shows the word frequency analysis with taxonomy [News Fake/Real X L1/L2/L3]. Each cell is filled with classified high frequency words by emotions (negative/neutral/positive). Here we choose top 100 frequent words.