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The social media Infodemic of health-related misinformation and technical solutions

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ABSTRACT

This paper discusses the role of social media algorithms in the spread of misinformation during the COVID-19 pandemic. It aims to propose solutions to combat misinformation and promote accurate, evidence-based public health information.

Introduction

The spread of false information among the masses is not a new phenomenon [1]. In recent years, the spread of inaccurate information has played a significant role in propagation of false narratives surrounding health issues, leading to the emergence of vaccine hesitancy and resistance to crucial COVID-19 public health measures [2–6]. Recent research indicates that fake information spreads faster than facts on social media platforms (SMPs), despite their potential for health education [7].

The term "Infodemic" refers to a vast amount of information disseminated through digital and non-digital channels during a disease outbreak [8]. It includes both legitimate scientific information and misleading, false narratives spread through various traditional and non-traditional communication channels, including SMPs [9,10]. The lack of measures to verify accuracy and authenticity has given rise to fringe opinions, disinformation, and misinformation, undermining public health response [9,10].The COVID-19 pandemic exemplifies the rampant spread of both disinformation and misinformation via SMPs during the pandemic, creating an Infodemic [11]. The fear and hysteria surrounding the disease led to confusion and a lack of confidence in public health measures [12]. False claims on SMPs contributed to avoidable hospitalizations and deaths worldwide.

A recent systematic review of 69 studies confirms the prevalence of health-related misinformation on SMPs [13]. This may be attributed to the in-built algorithms of the SMPs causing polarization and rapid spread of misinformation. Understanding its emergence and influence on healthcare decision-making is crucial. Utilizing deep learning to identify falsifications and fabrications may help in curbing misinformation [14]. This paper discusses relevant theories, the role of SMP structures, algorithms, and AI-based chatbots in distributing erroneous information. It aims to offer a credible framework to combat public health misinformation.

Disinformation vs misinformation

Prior to delving into any theories, it is crucial to establish a clear distinction between disinformation and misinformation. Disinformation refers to false or misleading information deliberately created and disseminated with the intention to deceive or manipulate others [15]. It

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is a deliberate effort to spread false information to achieve a specific agenda or gain an advantage, such as spreading false rumours for political propaganda or misleading the public for financial gain. Misinformation, on the other hand, refers to false or inaccurate information that is shared without the intent to deceive. It may be spread unintentionally, such as when people share false information without verifying its accuracy or sharing rumours without realizing they are untrue [15].

In summary, disinformation involves the deliberate creation and spread of false information with the intention to deceive, while misinformation is the sharing of false information without the intent to deceive. Both disinformation and misinformation can contribute to the spread of false information and have the potential to mislead and harm the public. Although the main difference is intent, both share the same characteristic of being distributed on SMPs.

The infodemic and theories of disinformation

Various theories explain the public's susceptibility to believe deceptive claims. The Medico-scientific conspiracy theory suggests that societal prejudices and biases can contribute to the Infodemic. Repeated exposure to medical myths can lead to a distrust of medical science, making individuals more susceptible to misleading claims from unreliable sources. This can result in treatment refusal and worse health outcomes [16].

People who doubt the effectiveness of medical science for one condition are more likely to reject scientific solutions for other issues due to misperceptions [17]. A cross-sectional survey in Great Britain, the U.S., and Canada found that fact-checks on COVID-19-related misperceptions had limited long-term impact due to political polarization and distrust towards political figures [18]. Repetitive exposure to reliable scientific information alone cannot completely counter misinformation.

Behavioural economics offers a potential explanation for how people process risk-related information through heuristics and nudges. Heuristic information processing involves cognitive mechanisms like the theory of illusory truth [19], theory of availability [20], fallacy of anecdotal vividness [21], and confirmation bias [22,23]. The combination of heuristic thinking and nudges significantly influences how individuals perceive and respond to risk-related information, impacting acceptance or rejection of scientific facts and public health measures.

SMPs create echo chambers, where some views dominate, influenced in part by the "Spiral of Silence" theory by Elizabeth Noelle-Neumann [24]. This phenomenon leads many to speak out while others remain silent, fearing social isolation [25]. It states that a congruent opinion climate and consumption of partisan sources encourage expressing opinions, while an incongruent environment leads to silence [26]. SMPs like Facebook's news feed can create a Spiral of Silence by prioritizing majority political opinions based on attention, shares, and comments [27]. Nevertheless, SMPs may also counteract this effect through anonymity, enabling users to express opinions without fear of negative social consequences (Fig. 1) [27]. A study on 992 left-winged adults found males more likely to share opinions online than females in news source comments [28]. Higher SMP usage correlated with increased likes and responses [24]. Those with more followers felt more confident expressing political views at work due to their expansive networks [29]. Supporters of childhood immunization were less involved in communication, feeling less passionate [30]. Conversely, anti-covid vaccination supporters shared emotional content and conspiracy theories, driving higher user engagement than legitimate sources [17,22,31].

Dismantling misinformation

Fake information is created by a multi-step process, including modifying content from others and passing it off as authentic to profit from SMPs and gain attention. SMPs promote captivating clickbait

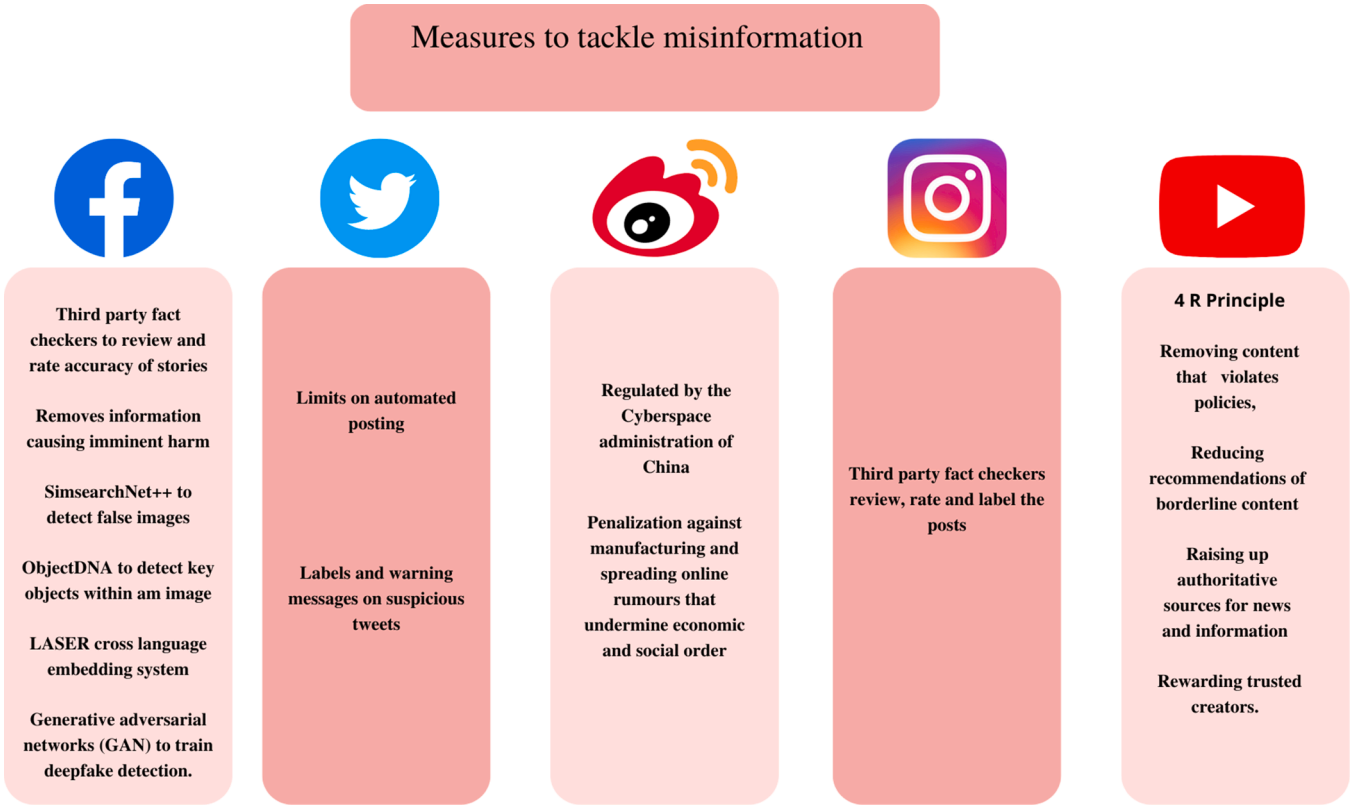

Fig. 1. Measures taken by the SMPs to tackle misinformation.
Fig. 1 shows the measures adopted by the SMPs such as Facebook, Twitter, Sina Weibo, Instagram, and YouTube to combat the spread of misinformation through their platforms.

content for profit [31]. The appeal of false information lies in its striking properties to the human brain rather than its inherent truth. Loft et al. found that personal stories engage audiences better than factual information [14]. Anti-vaccine SMP content relies on individual experiences, while pro-vaccine content draws from scientific literature but lacks emotional appeal [32]. The process of dismantling misinformation necessitates a comprehensive understanding of its systematic dissemination, that may at times be organized to intentionally sow doubt concerning health issues and undermine the credibility of medical professionals[32], referred to as an active "industry" in a viewpoint published by Nature [14,32].

The role of algorithms

Automated algorithms in SMPs offer personalized content, leading to confirmation bias [31,32] and the formation of polarized groups around shared narratives. High polarization levels result in rapid spreads of misinformation. This highlights the urgent requirement for a highly organized algorithm addressing individual needs and curbing misinformation on political, social, and health issues (Table 1).

Deep learning can improve the detection of fake information and rumours on platforms like Facebook and Instagram. While Sina Weibo has surpassed Twitter in users, its lower spread of misinformation may be due to stricter regulations [14]. Implementing machine learning in short message platforms like Facebook and Instagram, using recurrent and convolutional networks, can lead to faster and more accurate misinformation detection [26].

Role of artificial intelligence chatbots

'AI-driven infodemic' is a proposed public health threat from large language models (LLMs). Their superhuman-like speed makes them susceptible to misuse, disseminating content lacking scientific grounding. AI tools like generative adversarial networks (GANs) worsen the problem with deepfakes, further spreading misinformation on social media [27]. The Short messaging platform Twitter was plagued by bots leading to amplification of misinformation. However, by mandating stricter verification policies and usage of machine learning Twitter identified and eliminated these bots [33]. This depicts that the use of these tools would depend on the user, while it can be used with a positive intent, it also has the potential to be misused. Distinguishing between legitimate sources and AI chatbots require significant effort from readers [33].

Table 1
SMP algorithms that promote the spread of misinformation.

Platform	Algorithm
Twitter*[26]	The Latest and top-ranking tweets on the homepage are curated according to the user's likes, interests, and accounts most interacted with, most shared, liked, and replied to tweets. Amplification of right-leaning political content in most countries
Sina Weibo[53]	Customised homepage feeds based on search history, location, and trending topics.
Instagram [44, 54]	Curation of the home page based on signals like social engagement between accounts in the form of likes, tags, comments, and direct messaging. Relevance of content Timelines of post User's activity across the platform Explore option curates content from unrelated accounts based on mutual social connections and relevant user preference
Facebook [25]	Top post from source accounts most interacted with in terms of likes, comments, and reactions. Type of content based on history Lesser trending topics on the internet
Vkontakte[41]	A preference-based feed with posts from friends and community on the top Priority to fresh posts Posts with higher comments Posts in preferential format (videos, long texts, etc.)
YouTube[55]	Homepage: signals based on performance and personalization depending upon clicks, view duration, likes, user interest, and preference Search rankings: ranks depending upon keywords and performance Suggested videos: Topically related, videos often watched together, Videos watched in the past

Table 1 shows the types of algorithms used by different SMPs. These promote the dissemination of popular opinions lacking credible information to the top of the user's social media feed.

* Twitter is now known as X. At the time of writing, the Twitter version of this SMP was used.

The political facet

Political views significantly shape public opinion on health-related matters and public health literacy [34]. SMPs can amplify political influence through algorithms that favour partisan content, leading to the internalization of majority views. Some SMP owners are taking steps to address health-related disinformation during the pandemic. Platforms like Twitter and Mendeley might be more susceptible to disinformation due to their handling of retracted articles [35].

Establishment of belief systems

Flawed hypotheses and fabricated theories have the potential to disseminate misinformation rapidly among unsuspecting audiences via the unregulated web. This proliferation gives rise to myths and rumors, often preceding the dissemination of factual information [36]. Unfortunately factors such as political polarization, post-truth politics, SMP algorithms, motivated reasoning, and confirmation bias contribute to the dissemination of fake news. Fake information competes with real news, diminishing its impact [34]. Disseminating health information via SMPs lacks peer review and professional filtering, posing significant risks to online users' health. This issue was evident during the recent pandemic when unverified COVID-19 therapies gained traction on social media, leading to numerous adverse effects [37].

SMP algorithms can create filter bubbles that reinforce users' existing views and reject contrasting ones, leading to isolated echo chambers [34]. Research on COVID-19 information from millions of comments and posts on SMPs highlighted the impact of platform interaction patterns and audience characteristics on information spread, including misinformation [37]. The Infodemic worsens health inequities, disproportionately affecting younger individuals, females, and socially and economically vulnerable populations [38].

Management of the infodemic

Urgently addressing the challenge of AI-driven infodemics requires a comprehensive and collaborative approach involving SMP platforms, AI researchers, and policymakers. Enforcing guidelines to combat false information is crucial. For instance, Facebook removes millions of political propaganda-related posts, Twitter deletes billions of tweets and bots, and YouTube prioritizes authoritative news sources by adjusting its algorithm [34]. Health-related misinformation on SMPs can be exploited to promote specific political narratives, exacerbating partisan disagreement amid uncertainty about information reliability [37].

Promoting media literacy and critical thinking skills among the public is paramount. Equipping individuals to evaluate information critically makes them more resilient to misinformation [38]. This collaborative effort should balance addressing AI-driven infodemic threats while upholding freedom of expression. Stakeholders can work together to develop policies, protocols, and technological safeguards to mitigate risks and ensure responsible AI technology use.

The World Health Organization (WHO)'s campaign against health-related misinformation created a management framework [8]. It

involves identifying evidence, simplifying knowledge, amplifying activities, and measuring their impact [8]. To combat misinformation, the WHO advocates using digital verification platforms like the AFP fact-checker and connecting people with authoritative health sources through SMPs [8]. Analyzing emotional content, narrative types, information spread velocity, and using AI to assess similarities between WHO recommendations and daily news content on SMPs are also recommended [8]. The campaign endorses a pervasive counter-information campaign supplying evidence against false information [8].

The Mercury Project by the Social Science Research Council is an initiative combating erroneous information using AI and machine learning [39]. It funds a large and diverse cohort of researchers in the United States, Africa, Asia, and Latin America to discover new tools and interventions that support the sharing and uptake of accurate health information, reduce the spread of health misinformation, and increase the demand for vaccinations. Researchers examine misinformation patterns on digital platforms and social media, creating advanced AI models and algorithms to swiftly detect misleading content [39]. The project emphasizes empowering individuals with critical evaluation skills and collaborates with stakeholders to establish guidelines for tackling this issue [39].

Theoretical frameworks for the management of the infodemic

Misinformation undermines public health by fostering anti-science sentiments, scepticism toward experts, and eroding trust in media and democracy [4,40,41]. The Health Belief Model (HBM) is vital in countering the Infodemic, helping understand how people perceive health risks. In vaccination, higher intention to vaccinate is linked to perceptions of disease severity, personal susceptibility, and vaccine benefits, while lower intention is associated with lower perceptions of susceptibility and vaccine benefits. Fact-checking and information literacy are commonly used strategies, but some critics warn of lingering effects even after misinformation is corrected [42]. Valerie F. Reyna advocates using fuzzy-trace theory (FTT) and its concept of gist to understand how Misinformation affects decision-making and effective communication on SMPs [43]. When misinformation offers a more appealing interpretation than facts, it becomes more persuasive. Gist, based on knowledge and experience, evokes emotions by aligning with social values. Reyna suggests shifting scientific communication from rote facts to gaining insight while preserving integrity and acknowledging emotions and values [43].

Health-related communication on SMPs should be simple, straightforward, and emotionally engaging, utilizing personal narratives to provoke thought [32]. Platforms like Instagram and Facebook have been effective in disseminating health information and educating the public about diseases [44]. However, limited internet connectivity in developing countries hinders their contribution to and access to up-to-date scientific information [45].

Conclusion

The distribution and success of false information relies on emotional stories over facts and figures which make them more appealing to the public. Whilst freedom of speech is of paramount importance SMP providers have a responsibility to ensure that information is accurate and does not lead to dangerous and unsafe behaviour. There are also different motivating factors that need to be considered. The main point of communicating facts based on medical research is to enhance the global understanding of health issues, and to find optimal ways of managing them. By contrast SMPs favour revenue over the possibility of their content being apocryphal. SMPs are an excellent way of promoting useful information, but stronger rules, regulations and more effective algorithms need to be put in place to ensure the credibility of their output.

Key stakeholders and governance professionals should consider individuals seeking health information on SMPs and provide valid health-related information while accounting for susceptibilities [46]. Urgent measures are needed to protect susceptible individuals from incorrect information propagated by controversial influencers' partisan viewpoints. SMPs make it easy for non-experts to offer advice based on personal opinions rather than facts, leading to a significant amount of false information being shared [46]. Nutrition and vaccine-related health misinformation are particularly problematic, with people following influencers based on biased personal opinions rather than expertise [29,47]. SMP algorithms amplify these posts, creating the impression of a social movement driven by a few individuals' opinions [21,22]. Despite the challenges of misinformation, SMPs offer an opportunity for real-time dissemination of crucial health communication by public health authorities.

The COVID-19 State of Vaccine Confidence Insight Reporting System was created as a public health infodemic surveillance system [48]. To address the issue, solutions include raising public awareness, preventing stigma, and enhancing cooperation between policymakers, the medical community, and social media platforms [49]. Establishing a WHO—One Health approach is crucial [50]. Mitigation frameworks can reduce potential sources of stigma, with public figures and the medical community playing a vital role in reassuring and communicating guidelines [50–52]. Developing effective techniques to tackle misinformation on social media is essential, using empirical approaches and theories to explore algorithms, antecedents, and attributes [33]. Inputs from such research can aid in crafting persuasive and factual health-related messages, offering cautionary advice, and improving public health communication.

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LACKG serves as the social media editor for several Rheumatology journals and is Webmaster for APLAR and co-chair of EMEUNET social media sub-committee.

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CRediT authorship contribution statement

Flinta Rodrigues: Conceptualization, Visualization, Writing – original draft, Writing – review & editing. **Richard Newell:** Visualization, Writing – original draft, Writing – review & editing. **Giridhara Rathnaiah Babu:** Visualization, Writing – original draft, Writing – review & editing. **Tulika Chatterjee:** Writing – review & editing. **Nimrat Kaur Sandhu:** Writing – review & editing. **Latika Gupta:** Conceptualization, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

None.

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