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The impact of social media misinformation on public health interventions

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Abstract

Educating society about the benefits of public health interventions is a crucial step in overall intervention acceptance. Social media is a tool used to share thoughts, images, videos, and other personal information. However, problems arise when users share misinformation that then gets easily shared across networks conveying inaccurate facts. Therefore, spreading misinformation across social media platforms represents a serious difficulty in educating populations about current public health trends and overall acceptance of health-related information.

Research results obtained from different social media platforms indicate a significant association between spreading misinformation and the acceptance of public health interventions. At the same time, many researchers suggest that health professionals and healthcare-focused organizations should increase social media usage by posting correct information. Sharing accurate details can increase their influence on society to improve factual information acceptance. Additionally, there is an urgent need for more social media-related research to combat misinformation and its impact on public health. Many barriers prevent researchers from performing required scientific tasks because there is a lack of data, expertise, resource shortages, etc. Finding solutions for overcoming the outstanding research barriers is crucial in the fight against misinformation. Thus, potential solutions could lead to more studies conducted around this topic and help provide scientifically proven facts that could then be used to enhance the understanding of social media's impact on the spread of misinformation in real-time. Conducting more scientific-focused studies is crucial in assessing needs from an academic perspective. If researchers were allowed the time and resources to conduct more studies, this would help contract the rollout of misinformation. In conclusion, the spread of misinformation on social media represents a huge threat to public health and safety. It is now up to us to advocate for new social media regulations and establish innovative ways to combat misinformation.

Abbreviations: CDC: Centers for Disease Control and Prevention; WHO: World Health Organization; US: United States; SDoH: Social Determinants of Health; EMEA: Europe, Middle East and African countries; SVI: Social Vulnerability Index; BIPOC: Black, Indigenous and people of color; UK: United Kingdom

Introduction

We live in a digital world where technology is used for communication, networking, and many other purposes. Social media refers to all platforms leveraged to share and post personal thoughts, images, videos, stories, etc., within the network. Social media examples include Facebook, Twitter, Instagram, Snapchat, YouTube, etc. The popularity of social media is continuously increasing, as indicated by the prediction that the number of people on social media will reach 4.41 billion by 2025 [1]. Additionally, social media is becoming a prevalent resource of information for many users [2].

Many studies are using social media data to explore public opinion about certain events, such as elections, natural disasters, epidemics, pandemics, vaccinations, etc., [3-9]. Social media platforms provide a bigger picture about the public acceptance or rejection of information that users find online or in the news. In addition, the analysis of public posts can establish a better understanding of how powerful the network is in spreading information and misinformation. Wu, *et al.*, emphasized the difference between misinformation and disinformation [10]. While misinformation refers to unintentionally created false information, disinformation is intentionally created to deceive others. However, it is particularly hard for readers to understand the distinction as many may not fully understand what misinformation or disinformation means and how it impacts them on social media. Therefore, their definition of misinformation is adopted throughout this paper as "false or inaccurate information that is deliberately created and intentionally or unintentionally propagated".

Methods

The methodology of this study focused on detailed research performed centered on hesitancy toward public health interventions and the association between hesitancy and social media activity. The following subsections provide detailed information about the study findings.

Public health interventions

Public health interventions refer to all possible efforts made in order to improve health on a community or population level [11]. Some achievements of public health interventions include vaccination,

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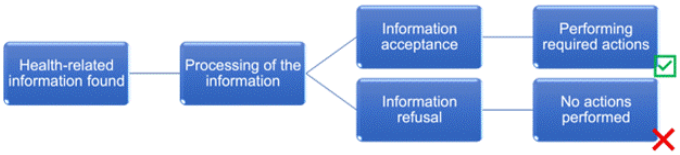

Figure 1. Finding and processing health-related information can produce two possible outcomes: information acceptance lead to performing required actions, while information refusal leads to not performing any required actions

tobacco control, reduction in child mortality, improved preparedness and response to global health threats, etc., [12]. Even though public health interventions are crucial for the overall health at the population level, the acceptance of such interventions may serve as an appropriate step in reaching outstanding public health outcomes. Sekhon, *et al.* defined the acceptability of healthcare interventions and the theoretical framework to establish acceptability for both perspectives: interventions deliverers and recipients [13]. From both perspectives, acceptability stands for the extent to which individuals consider the intervention appropriate.

Besides acceptability, another important factor to be considered to perform public health interventions successfully is health literacy.

"Personal health literacy is the degree to which individuals have the ability to find, understand, and use information and services to inform health-related decisions and actions for themselves and others [14]."

Individuals must be able to find and understand health-related information in order to accept and perform required actions. Therefore, acceptability and health literacy might play a significant role in public health interventions and their successful outcomes, as indicated in (Figure 1).

Approximately half of Americans use social media platforms as a primary news resource [2]. However, many social media posts contain misinformation that easily gets shared across the network. The study of Vosoughi, *et al* states that misinformation posts spread faster over the web than posts that do not contain misinformation [15]. This indicates that many people encounter incorrect health-related information that poses a big threat to the public health system, aiming to educate the public about the benefits of ongoing interventions. For example, suppose many people re-share a post about the incorrect risks of taking a certain vaccine. In that case, many people refuse to get vaccinated because they believe such false claims. Thus, the misinformation spread on social media represents a big problem for public health professionals whose primary goal is focused on improving health at the population level.

History of vaccine hesitancy

According to World Health Organization (WHO), 'vaccine hesitancy' is the delay in accepting or refusing to get vaccinated even though vaccines are available to the public [16]. The term 'vaccine hesitancy' is not new to the public health system, and it represents one of the biggest threats to global health [17]. The WHO has established three main reasons which cause vaccine hesitancy:

1. *Confidence* refers to the mistrust towards the health system/ vaccination, which might prevent individuals from getting vaccinated.
2. *Complacency* is when individuals believe that the risk of getting a disease is low, so there is a belief that vaccination is not needed.
3. *Convenience* refers to the quality of service and the degree to which vaccines are administrated conveniently and comfortably.

Even though vaccine hesitancy has been an obvious problem during the COVID-19 pandemic, this is not a threat that has recently emerged. Despite the healthcare efforts to ensure the safety of vaccinations throughout history, there is still a belief that vaccinations might have a more harmful effect than the disease itself [18]. In addition, establishing vaccination as mandatory might create a contradictive reaction from certain individuals [19]. Therefore, vaccine hesitancy was a challenging problem to approach even in the past, despite vaccinations being proven to effectively prevent various diseases.

According to US Food and Drug Administration, the flu vaccine is the best prevention against getting the flu which is defined a disease caused by the virus influenza that can lead to hospitalization or death [20]. Schmid, *et al.* performed a systematic review on influenza vaccine hesitancy [21]. The main research gap emphasized is the lack of studies about parental vaccine acceptance for children at high risk. Another study explored influenza vaccine hesitancy in King Abdulaziz Medical City, Saudi Arabia [22]. Their results suggest that 17% of study participants are vaccine-hesitant due to beliefs that vaccination does not have benefits, they are already healthy, or that vaccines cause serious side effects. Similarly, 60% of interviewed parents in England were concerned about the need and safety of the influenza vaccine, which was cited as the main reason they did not have their children vaccinated [23]. In Canada, vaccination against influenza is declining, especially among high-risk groups such as people who are 65 or older [24]. Additionally, pregnant women remain hesitant to receive influenza and Tdap (Tetanus, Diphtheria, and Pertussis) vaccines despite being aware of the disease severity for them and their unborn child or infant [25].

Another example is polio vaccine hesitancy in Pakistan and Nigeria [26]. According to the study conducted in Pakistan, some of the reasons to not revoice polio vaccine were the perceptions that it causes infertility or it is connected to some foreign conspiracy [27]. In the case of Nigeria, thirty percent of study participants believed that the polio vaccine might be harmful [28]. In summary, vaccine hesitancy as a threat to population health did not recently emerge, and appropriate actions must still be taken to reduce overall vaccine hesitancy worldwide.

COVID-19 pandemic and vaccine hesitancy

On December 19, 2019, a group of patients started experiencing the first COVID-19 symptoms in Wuhan, China [29]. WHO declared COVID-19 a global pandemic on March 11, 2020. Since COVID-19 is an infectious disease and some individuals might need serious medical treatment [30], performing a required public health intervention became a critical step in fighting the pandemic. Therefore, as one of the major public health interventions to combat infectious diseases, vaccine deliveries against COVID-19 started in December 2020 [31].

Many recent studies focused on vaccine hesitancy during COVID-19 pandemic, as vaccine acceptance became a crucial step in combating the pandemic, rather than the vaccine effectiveness [32]. A study conducted by Murphy, *et al.* in 2021 [33] found that vaccine hesitancy was evident in 35% of the population in Ireland and 31% of the population in the United Kingdom (UK). They also found that a common characteristic of the study respondents was similar mistrust towards traditional information resources. These results suggest that vaccine acceptance plays a significant role in successful vaccine intervention. Also, Razai *et al.,* suggest that vaccine hesitancy is higher among ethnic minority groups in the UK [34]. This raises concerns about the ability of black, Indigenous, and people of color (BIPOC) populations to receive and understand health-related information and their willingness to receive a vaccine.

Another factor that might play an important role in vaccine hesitancy is the social vulnerability index (SVI). SVI refers to the potential negative effects communities might experience during certain external stresses, such as disease outbreaks [35]. As SVI is higher in certain areas, that means that these areas are at higher risks before, during, or after a stressful event occurs. A recent study [36] showed that there is a significant correlation between health literacy and SVI with vaccination rate in the US at the state level. This means that social determinants of health (SDoH) must be taken into consideration when planning an intervention. A positive correlation between health literacy and vaccination rate indicates that populations which can absorb health-related information are more likely to get vaccinated. On the other hand, more vulnerable US states (states with higher SVI) show lower vaccination rates. Additionally, study results suggest that there is a correlation between sentiments of tweets and vaccination rates. Therefore, social media is a useful tool to leverage in order to help the public foster trust in the health system.

Another study [32] explored vaccine hesitancy in EMEA (Europe, Middle East and African countries) countries, showing low vaccine acceptance in countries throughout the Middle East, Africa, Russia, and several European countries (e.g., Italy, Poland, France). The study's conclusion suggests that governmental efforts, in collaboration with social media efforts, can reduce vaccine hesitancy. In Portugal, for example, mistrust towards the vaccine and healthcare system, job loss, being younger, and the belief that information provided is contradictory are some of the main reasons behind vaccine hesitancy [37]. Hence, vaccine hesitancy is a more complex problem influenced by many factors that must be explored. According to Lucia, *et al*. there is a potential vaccine hesitancy developed among US medical students [38]. This also represents a big problem for the US healthcare system as healthcare professionals also refuse to get vaccinated. Mistrust towards the healthcare system also comes from healthcare workers, making the problem of vaccine hesitancy even harder to approach. Therefore, campaigns to combat vaccine hesitancy must be developed for both healthcare professionals and patients. Finney Rutten, *et al.* [39] offered different paths that clinicians can take to address vaccine hesitancy when speaking to their patients, such as making strong recommendations, providing information about the disease, addressing barriers, and appealing to prosocial behavior, etc. They also pointed out the relevance of education/training of clinicians about COVID-19 vaccine information, so clinicians are ready to address any questions/concerns regarding vaccination.

Public health interventions and misinformation

As stated in the previous sections, vaccine hesitancy is caused by many different reasons. One of the main reasons is the mistrust towards the public health system. The logical method to solve this problem would be to educate the population about the vaccination benefits and state the facts surrounding vaccination as the crucial step in preventing disease. However, as social media platforms are becoming the base information resource [2], the spread of health-related misinformation on social media diminishes the success of public health interventions. Despite public health efforts to inform the public about the ongoing interventions, it is challenging to convince the public to have trust when many rumors are constantly being shared over the Internet. Thus, misinformation spread on social media directly impacts health literacy and vaccination acceptability needed to reach public health intervention goals.

Many research studies have been conducted to understand better social media activity and the association between vaccine hesitancy and social media posts. For example, Sallam, *et al.* suggest that there is a high vaccine hesitancy in Jordan and Kuwait [40]. The spread of misinformation and rumors on social media platforms greatly impacts vaccine hesitancy in-country. Also, the [41] study suggests that public health messaging could be a way to mitigate vaccine hesitancy. Alternative methods are still needed in cases where some are still vaccine-hesitant.

Spreading misinformation has a negative impact on other public health interventions as well. For example, Suarez-Lledo and Alvarez-Galvez performed a systematic review to identify the most prevalent health-related misinformation topics on social media [42]. They examined many articles published via resources such as PubMed, MEDLINE Scopus, and Web of Science. Their findings suggest that topics such as vaccines, drugs or smoking, noncommunicable diseases, pandemics, eating disorders, and medical treatments are the most prevalent ones on social media platforms. Misinformation was mostly detected in topics such as smoking and drugs, followed by topics with moderate misinformation rates, such as vaccines, diets, and diseases. Also, they report that the lowest rate of misinformation is found in posts related to medical treatments.

During the COVID-19 pandemic, many different conspiracy theories emerged. For example, a theory that smoking and drinking alcohol could protect against COVID-19 was flowing on social media [43]. Study results showed statistical significance between exposure to these claims and increased tobacco and alcohol consumption. Another study [44] found that watching misleading videos on YouTube about e-cigarettes and hookahs resulted in more positive attitudes towards such products than participants' attitudes watching control videos. In addition, Wright, *et al.* examined participants' attitudes toward the consumption of e-cigarettes after exposure to tweets about their harmfulness [45]. Their results show that users seeing tweets stating that e-cigarettes are as harmful as smoking had a lower intention to purchase them. Similarly, participants exposed to tweets claiming that e-cigarettes are harmless had a higher intention to buy them. Consequently, the association between misinformation on social media and public health interventions is evident, and the spread of misleading claims must be reduced to increase the achievement of interventions.

Results

This study presents the potential benefits of social media for public health and the proposed solutions for reducing the misinformation spread across the platforms. Finally, this study calls for more research around these topics and addresses the main issues researchers face in their attempt to participate in such research.

Benefits of social media on public health interventions

Even though the spread of misinformation on social media represents a big problem for public health efforts, social media can still serve as a useful tool for increasing their acceptance. For example, reducing vaccine hesitancy is one of the major goals for vaccination as a public health intervention. Therefore, social media must be leveraged to promote vaccination and enhance public awareness of the importance of vaccine administration. Several possible usages of social media benefit overall population health and increase interventions acceptance, such as:

1. Use social media to share informative posts about ongoing interventions, their benefits, and their importance for overall population health.
2. Prompt users who have a great influence to post about the effectiveness and benefits of the intervention.

3. Create public pages where health officials can share reliable health sources, so the public knows where to look for reliable health-related information.
4. Create transparent public pages where people can ask questions and receive answers from healthcare professionals.
5. Promoting usage of social media data in research analysis can provide useful insights into the overall acceptance of factual information. Therefore, health officials need to understand better what information is not well delivered to target populations. This would further assist the healthcare workforce when targeting populations needing further or better education.
6. Re-sharing posts with reliable information can help foster a positive attitude towards the desired intervention.

These are suggested actions that can be used to mitigate and reduce misinformation on social media. If social media is an effective vehicle for spreading misinformation, it can also be used for disseminating accurate information while educating the population about factual health-related issues. However, such benefits are not enough to completely resolve the spread of misinformation. Other actions must be performed to accomplish desired intervention goals, such as conducting more research, interpreting study results, and increasing digital and health literacy.

Proposed solutions for reducing the spread of misinformation

Here are the proposed solutions aimed at resolving misinformation spread on social media to reduce hesitancy toward public health interventions:

1. Perform more research on social media misinformation and its association with public health interventions.
2. Interpret study results and use social media to educate the public about the importance of these interventions.
3. Increase the overall digital and health literacy of individuals to help them distinguish between reliable and unreliable sources.

The results summary of the current research is not enough to combat misinformation. More research is needed to understand better social media activity and how to reduce the spread of misinformation. Explaining and sharing the results of peer-reviewed research is a crucial step in educating the workforce and public about the problem that misinformation and intervention hesitancy present for the entire society. Presenting more evidence related to the negative impact of social media misinformation spread might lead to positive outcomes for acceptance of public health interventions.

Call for additional research

Performing more research related to misinformation on social media and public health interventions could provide useful facts to share with the population while mitigating intervention hesitancy. There may be several reasons which prevent researchers from doing a detailed analysis of social media activity, such as:

1. **Lack of data**: The crucial part of every research project is the data used for the analysis to draw conclusions. Social media data is extremely limited. Most social media platforms provide only a sample of public posts or posts coming from public pages. Therefore, the analysis of posts may help obtain insights but drawing an accurate conclusion is difficult.
2. **Local language**: Refusal of public health interventions is a global problem. The analysis of posts in one language only provides detailed information about certain locations or parts of the world.
3. **Lack of expertise**: Performing detailed analysis and manipulating large social media data sets might not be in the public health professionals' knowledge base. This is an opportunity to draw upon computer scientists or data analyst experts to collaborate with and perform such research.
4. **Lack of financial resources**: Every research project requires funding to support researchers, inclusive of the necessary tools, data, etc. Finding resources to cover these costs might not be an easy task.
5. **Lack of curriculum**: Social media, public health interventions, and health informatics have become important domains in current and future workforce development. Incorporating a curriculum covering such topics might get more researchers interested in working on research projects.

Proposed steps to increase intervention acceptance are presented in (Figure 2).

Discussion

Principal Results

The analysis of existing studies on social media misinformation, public health intervention hesitancy/acceptance, and SDoH indicated a strong connection among these terms. For example, intervention hesitancy is more prevalent within vulnerable communities where the population has a lower ability to retrieve and understand health-related information. Similarly, intervention acceptance is lower in geographical areas where there is more misinformation shared over social media networks. Even though the measurement of misinformation spread on social media in certain areas might be a more complex problem, the results emphasize that such a relationship exists. In addition, the usage of social media around the world is constantly increasing, leading to a large percentage of the population being active social media users. Therefore, social media can be used as a tool to understand public perception about ongoing interventions and identify areas where additional education is required to increase overall health literacy in such communities.

Limitations

The main limitation of this study is the spread of misinformation on social media and SDoH as triggers for public health intervention hesitancy. Even though misinformation spread presents a big threat to public health systems, additional reasons that contribute to unsuccessful interventions are not explored in detail within this paper. In addition,

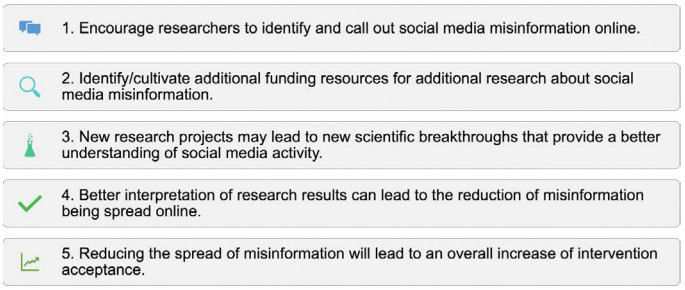

Figure 2. Additional scientific research about social media activity is needed to help decrease social media misinformation and increase intervention acceptance

the lack of data and statistical analysis to describe a relationship between social media misinformation spread and intervention acceptance is another limitation since the study only focuses on studies previously conducted.

Comparison with prior work

This study discusses different aspects of public health threats and establishes a comprehensive connection among them. Despite many studies performing a detailed literature review around related topics, none of the studies attempted to summarize the findings of studies on different topics and explore their association. Finally, this study provides a strong argument that should encourage researchers to engage in additional research, potentially reducing intervention hesitancy and increasing trust in public health systems worldwide.

Conclusions

One of the crucial steps in fighting the COVID-19 pandemic is increasing vaccination rates worldwide. However, vaccine hesitancy prevents parts of the population, around the world, from getting vaccinated. At the same time, spreading misinformation on social media directly impacts the public opinion about vaccination and increases vaccine hesitancy. A major step in combating misinformation on social media is performing more research. More research is needed to understand social media activity better while educating the population and healthcare workforce about the association between social media misinformation spread and public health interventions. Detailed insights into social media activity and how it impacts ongoing interventions must be established to prevent the spread of misinformation and educate the public about such interventions' real and tangible benefits.

Conflicts of interest

None declared.

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