

WHO and digital agencies: how to effectively tackle COVID-19 misinformation online

Federico Germani ¹, Andrew B Pattison,² Monta Reinfelde²

To cite: Germani F, Pattison AB, Reinfelde M. WHO and digital agencies: how to effectively tackle COVID-19 misinformation online. *BMJ Global Health* 2022;**7**:e009483. doi:10.1136/bmjgh-2022-009483

Handling editor Seye Abimbola

Received 28 April 2022

Accepted 11 June 2022

INTRODUCTION

On 30 January 2020, as a consequence of the globally deteriorating epidemiological situation, WHO Director-General Tedros Adhanom Ghebreyesus declared the COVID-19 situation to be a public health emergency of international concern.¹ The global health disaster has been exacerbated by a concomitant epidemic of misinformation online, which has been referred to as an ‘infodemic’.² The prominent feature of this infodemic is an epidemic-like circulation of fake news, which includes scientific misinformation about COVID-19 and vaccines.³ Misinformation circulates through digital channels faster and more effectively than accurate information does.⁴ Through social media in particular,^{5 6} unfounded rumours and conspiracy theories can have a broad reach, greatly contributing to people’s beliefs and behaviours. Scientific misinformation has been a large challenge for the implementation of solutions to halt the ongoing pandemic, and high rates of vaccine hesitancy have been a deterrent to a successful management of COVID-19. COVID-19 misinformation is driven by conspiracy theories on the origin of the pandemic, on the dangers posed by global vaccination campaigns or by inaccurate measures to prevent or treat the disease.^{7 8} For instance, one of the most popular conspiracy theories on the origin of the pandemic proposes that the outbreak was a plan to mitigate overpopulation through the employment of massive vaccination campaigns. Other popular conspiracies propose that 5G technology causes illnesses due to electromagnetic radiation and that the pandemic serves as a cover for the health damages caused by the new technology. These conspiracies have had real-life effects, with people burning 5G masts or attacking telecommunication workers.^{9 10} Furthermore, misinformation reduced adherence to

Summary box

- ⇒ WHO convened the Tech Task Force (TTF) on COVID-19, with companies in the social media and tech industry from around the world to identify strategies to limit the circulation of fake news and harmful contents.
- ⇒ WHO has worked with Google to ensure that people who search information related to COVID-19 are exposed to evidence-based information.
- ⇒ WHO has been actively promoting evidence-based messages, has worked with tech companies to pull down misinformation from the Internet, and with the support of digital agencies – has created tools, applications, and new channels to amplify the reach of trustworthy health information.
- ⇒ Joint efforts between WHO and the private sector can promote health and keep the world safe.

mask regulations and social distancing measures,³ due to the broad misunderstanding of the mechanisms of SARS-CoV-2 transmission, COVID-19 symptoms or the concept of herd immunity. All these factors have had profound negative effects on the perception of the dangers posed by COVID-19.

In this process, political trust has been shown to play a direct and indirect role, proving that rumours and misinformation can spread from corners of the internet as well as from institutional figures.¹¹ As an example, in 2020 a prominent political figure erroneously stated that chloroquine and hydroxychloroquine were approved by the US Food and Drug Administration for the treatment of COVID-19.¹² This was followed by a large request for these drugs, causing a shortage of medical supplies for those patients suffering from diseases which require chloroquine and hydroxychloroquine.¹³ Misguided trust mixed with misinformation also led people to inhale disinfectants, to get exposed to ultraviolet radiation to kill the virus, as well as to create cocktails of drugs to make vaccines.



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Institute of Biomedical Ethics and History of Medicine, University of Zurich, Zurich, Switzerland

²Digital Health and Innovation, World Health Organization, Geneva, Switzerland

Correspondence to

Dr Federico Germani;
federico.germani@uzh.ch

For example, drinking methanol has caused the death of at least 300 people in Iran in 2020.¹⁴ Therefore, misinformation is an obstacle to control the spread of the disease and minimise infection rates, and it can constitute a direct threat to life.

During the pandemic, private corporations working in the digital and social media sector have been encouraged to adapt their misinformation policies to account for the global health damages that misinformation can cause, while also accounting for the potential dangers this poses on freedom of speech.^{8 15 16} Misguided trust and misinformation can be challenged through the combined action of myth busting and information production by global health institutions,¹⁷ but also through actions taken by digital agencies to reduce circulating misinformation¹⁶ as well as through the action of individual digital health influencers,^{18–21} who are of utmost relevance in creating a functional network of public health providers for accurate information about COVID-19. In this context, ensuring the highest possible turn-out for the ongoing worldwide COVID-19 vaccination campaigns should be a primary objective, as unsuccessful global vaccinations could undermine the efforts to protect the population, in particular vulnerable individuals with advanced age, comorbidities or a compromised immune system. The growth of the antivaccine movement on social media, and related vaccine misinformation online, constitute challenging tests for global health institutions.^{8 22–24}

These challenges cannot be easily overcome without the help of private corporations, which are able to control the flow of information and misinformation. It is therefore absolutely necessary that solutions to fight against misinformation are found together with public institutions and digital agencies.¹⁶ In this paper, we highlight the strategies adopted by WHO since the beginning of the pandemic to reduce COVID-19 misinformation, describing the collaborative efforts between WHO and leading tech and digital agencies. These approaches have resulted in the successful reduction and management of COVID-19 misinformation online, have saved many lives and have greatly contributed to the reduction of the global burden on public health caused by the pandemic.

MANAGING INFORMATION ONLINE: A JOINT EFFORT BETWEEN WHO AND TECH INDUSTRY

Managing information online and fighting misinformation are challenging and require strategies that have a broad outreach, are built on successful communication strategies (based on risk communication and community engagement²⁵) and are successful in bringing health messages into the lives of people.²⁶ Soon after the initial outbreak of the pandemic, WHO has made tremendous efforts to mitigate the wave of COVID-19-related misinformation, raising contents containing proper information, developing new tools and identifying relevant and unexplored communication channels. The core of WHO strategy has been to get into the user's digital journey,

Box 1 List of companies which collaborated with WHO from the onset of the pandemic to tackle misinformation and distribute and enhance access to accurate information

- ⇒ AirBnB
- ⇒ Amazon
- ⇒ Disney eBay
- ⇒ Expedia
- ⇒ Facebook
- ⇒ FitBit
- ⇒ Genies
- ⇒ Global System for Mobile Communications (GSMA)
- ⇒ Google
- ⇒ Google Fit
- ⇒ Group M
- ⇒ Healthcare Triage
- ⇒ Hill+Knowlton Strategies
- ⇒ Instagram
- ⇒ LinkedIn
- ⇒ Lumen5
- ⇒ Mapbox
- ⇒ Magic Unicorn Inc
- ⇒ Mercado Libre
- ⇒ Ndemec Creations
- ⇒ NewsGuard
- ⇒ Out There Media / Out There Impact
- ⇒ Playrix
- ⇒ Praekelt.org
- ⇒ Psyon Games
- ⇒ Salesforce
- ⇒ SoulMachine
- ⇒ Tableau Foundation
- ⇒ The Spinoff
- ⇒ Tinder
- ⇒ Turn.io
- ⇒ Uber
- ⇒ Umbogo
- ⇒ Viamo
- ⇒ Viber
- ⇒ Wavemaker
- ⇒ WeGaveWhat
- ⇒ WhatsApp
- ⇒ WPP
- ⇒ Wunderman Thompson
- ⇒ YouTube
- ⇒ Xbox

rather than change the user behaviour, allowing health information to be brought to people during their daily activities. For this reason, at the onset of the pandemic, WHO convened the Tech Task Force on COVID-19, composed of companies in the social media and tech industry from around the world, to promote collaborative efforts and identify joint strategies to limit the circulation of fake news and harmful contents, thus promoting a healthier digital space online (box 1).

The first meeting between WHO and representatives of digital agencies took place on Facebook in February 2020,²⁷ and since then virtual meetings have been held on a monthly basis. WHO has worked with Google to

ensure that people who search information related to COVID-19 are exposed to evidence-based information from WHO and other accredited agencies. This has been one of the highest priorities in the WHO agenda, since Google is the widest used search engine worldwide with a 92.05% global market share as of February 2021.²⁸ It is estimated that people have searched on Google for COVID-19-related information 400 billion times between March and December 2020.²⁹ In March 2020, Google and WHO launched an Organized Search Results Panel (OSRP) on COVID-19, in which users can retrieve reliable information.³⁰ In the OSRP, results are not ranked through classic Google Search Engine Optimization algorithms, but promote only credible information, either from WHO, national governments and health agencies or from a list of reputable news media. Further, relevant local information is given depending on the geographical location of the user, and includes an updated number of cases, information on local COVID-19 safety measures or regulations, or vaccination data. More recently, on 11 March 2021, the joint effort resulted in the launch of a similar OSRP concerning COVID-19 vaccines, through which safety and efficacy information is provided to an increasingly interested public.²⁹ In fact, Google searches related to vaccines increased 33-fold between December 2019 and June 2021.³¹

Search engines are not the only channel through which people search for information online, or information related to public health. In fact, a large volume of health information is sought on social media, including Twitter and Facebook.³² Social media platforms have been shown to positively influence awareness of behaviours needed to prevent COVID-19 infection or spreading.³³ For this reason, WHO and Facebook collaborated for the creation of a tool, namely the Facebook COVID-19 Information Center, which brings accurate information to users and reduces the potential exposure to misinformation on COVID-19 and vaccines.³⁴ Users searching COVID-19-related terms land on a page which provides users with prevention tips and other evidence-based information, bringing WHO contents directly to Facebook users.³⁵ Between January and April 2020, Facebook directed over 2 billion people to WHO resources, converting in over 350 million clicks, through the COVID-19 Information Center, as well as through Facebook and Instagram pop-ups.³⁶ Google and Facebook retrieve data from local ministries that routinely release the updated number of COVID-19 cases, deaths or vaccinations. To further refine and improve the quality of the information provided through these channels, WHO provides data whenever local ministries are unable or unwilling to provide them, thus filling an otherwise dangerous gap of information in areas of the world, such as Yemen, where healthcare systems are often not able to sustain the impacts of infection surges.^{37 38}

WHO has also been able to secure grants for ad space with Google, YouTube and Facebook.^{39 40} This pro bono ad space promotes health messages under WHO

guidance. The collaboration between Google and WHO has been very successful: the executive meeting between Google's Chief Executive Officer (CEO) Sundar Pichai and WHO's Director-General Dr Tedros Adhanom Ghebreyesus in March 2020 resulted in a US\$250 million ad grant for the WHO.³⁹ Google Ad Grants has been particularly useful to respond to misinformation queries concerning COVID-19 and vaccines, as well as to understand trends and immediately fill information vacuums. For instance, driven by the deepening COVID-19 crisis in India, during the week between 27 April 2021 and 3 May 2021, WHO responded to 14.7 million searches from the country, corresponding to a 90.9% increase in weekly impressions, and a staggering increase of 3450% in the query 'proning technique coronavirus'. With Google Ad Grants, in just a few months WHO was able to respond to nearly 50 million misinformation searches, with more than 90 million visitors landing onto the WHO's website, with peaks of 500 000 people per day. Google Ad Grants responded to more than 1.45 billion user searches as of 5 July 2021, with Latin America accounting for 42% of ads shown during the peak of infections in the continent, highlighting the relevance of providing people with multiple channels of accurate information in order to properly respond with effective prevention or containment measures (figure 1). Further, as of 26 January 2021, YouTube has served 400 billion impressions on information panels related to COVID-19, with links to WHO's web pages.⁴¹ Facebook, as announced in a post by CEO Mark Zuckerberg, has given unlimited free ads to WHO to promote health information of global and local relevance.⁴⁰ Finally, a Microsoft-WHO ads campaign led to 12 million impressions in the USA, and to a total of more than 30 million impressions worldwide between 7 June 2021 and 14 July 2021.

The user's digital journey is not always characterised by active searches for COVID-19 information through search engines or social media. Therefore, WHO has developed strategies, in collaboration with digital agencies, to enter the user's digital journey and provide bits of information even when the user is not necessarily looking for it. For example, the online dating application Tinder, with an audience size of 7.86 million people in 2019 in the USA alone,⁴² ran a campaign promoted by WHO through display native cards, encouraging users to stay safe and informed about COVID-19.⁴³ While 'swiping' for a future date, Tinder promoted health information that was displayed to nearly 26 million people across 22 markets, lasting from several days to a few weeks depending on the market. The most responsive countries were Bangladesh, India, Pakistan, Sri Lanka and South Korea. Of note, Tinder has also led pro bono efforts to help WHO translate its contents in multiple languages, additionally receiving support from the translation teams of Facebook, Google and Viber. Another WHO strategy to deploy health information into people's lives is through collaborations with the gaming industry, whose market has been growing substantially during the pandemic.⁴⁴



Figure 1 Efficacy of Google Ads-based WHO strategy. WHO obtained from Google a US\$250 million ad grant. The campaign responded to more than 1.45 billion user searches and 50 million misinformation queries on Google. As of 5 July 2021, this led 167 million visitors to the WHO website with peaks of 500 000 people per day. During the peak of the COVID-19 wave in South America, the WHO campaign responded to a vast amount of searches coming from the continent, accounting for 42% of the total queries worldwide.

The gaming industry helps amplify public health messages to young and unique audiences and supports WHO by providing visibility to contents and promoting health messages through in-game integrations. In fact, video games have been proposed to be effective tools to promote health messages,^{45 46} including weight control.⁴⁷ An example of these applications includes the online game Chudo, developed by the gaming company Magic Unicorn, in which virtual characters can wear a mask.⁴⁸ WHO is currently working on several other projects with companies including Playrix,⁴⁹ Ndemc Creations, GOARN and Pson Games.⁵⁰ Stemming from these collaborations, a game called ‘Plague Inc: The Cure’ was released on 28 January 2021 and allows players to deal and respond to the challenges of a global pandemic.⁵¹ WHO is also collaborating in the creation of ‘Antidote – Vaccine Defense’ by Pson Games, in which players learn to understand how a vaccine works and defend cells from viral and bacterial offences.⁵² For the #HealthyAtHome campaign, WHO has also been collaborating to the launch of Angry Birds Friends physical activity tournament, in which players receive tips on how to stay active and healthy during the pandemic.⁵³

CHANGING MISINFORMATION POLICIES ON SOCIAL MEDIA

Misinformation, conspiracies and falsehoods concerning COVID-19 and vaccines constitute harmful threats for individual and public health. Misinformation can prevent people from encountering accurate, life-saving information on COVID-19. It can directly cause harm, as when it promotes life-threatening prevention methods or cures, and it can cause harm indirectly, as when it promotes ineffective cures. Given the above-mentioned consequences misinformation can have, WHO has worked with digital

agencies to suggest changes to their misinformation policies in light of the COVID-19 pandemic and infodemic, in order to adopt a wider definition of harm and threat to life as a consequence of misinformation. For example, WHO has worked with YouTube to enhance their COVID-19 Misinformation Policy.¹⁶ Following weekly calls between WHO and YouTube, the video platform has banned any COVID-19-related content that contradicts WHO advice; as pointed out by YouTube CEO Susan Wojcicki, anything against WHO recommendations is ‘a violation of our policy’.⁵⁴ These policy updates led to the removal of more than half a million YouTube videos between February 2020 and January 2021.⁴¹ WHO also worked with Facebook policy teams to remove contents that could constitute threats to health and life. Facebook prohibited misinformation that contributes to the risk of violence or physical harm, but more recently also enacted policies to reduce the distribution of contents related to vaccines that, though not directly contradicting Facebook rules, still undermine global vaccination efforts and spread falsehoods about vaccines.⁵⁵ Furthermore, these policy updates that match WHO expectations must be met with a rigorous procedure of policy enforcement. In order to potentiate the efforts of misinformation vigilance on YouTube and Facebook, these platforms have granted WHO access to a fast-track reporting system, which allows WHO staff to flag misinformation, leading to a quick removal of contents that break their policies.

PROJECT FIDES: A COMMUNITY OF HEALTHCARE INFLUENCERS FIGHTING COVID-19 MISINFORMATION

The misinformation ecosystem on social media is constituted by an intricate network of influencers, which produce the vast majority of contents containing

falsehoods concerning COVID-19 and/or vaccines, and by a large number of users, which constitute an echo chamber for the contents generated by the small fraction of influencers. This dynamic has been revealed to be key for the successful distribution of antivaccination messages on Twitter.⁸ In order to counteract the action of ‘misinformation influencers’, healthcare influencers have been suggested to play a relevant role in debunking myths and conspiracy theories, as well as providing access to valuable and accurate information for their followers and beyond.⁸ In addition, it has been shown that influencers may play a relevant role in public health communication amid a health crisis.⁵⁶ WHO has therefore been interested in supporting healthcare influencers to promote evidence-based messages about COVID-19 and vaccines through various social media platforms.⁵⁷ Influencers can, in fact, adopt the most appropriate communication strategy for their niche of followers, thus allowing for a detailed personalisation of public health messages, in line with what has been proposed in a recent ethics and communication framework to deal with public health emergencies.⁵⁸ WHO’s Project Fides sought to build a community of healthcare professionals, creating a network of well-connected science communicators on social media. WHO also worked to coordinate the contents and efforts of individual influencers, and to listen to their individual struggles with trolls and haters, in an attempt to identify these and flag their profiles for misinformation. For example, last year, WHO and YouTube collaborated with actor and comedian Jon Glaser to produce a short animated video entitled ‘The Holiday Playbook: Don’t be a Holiday Super Spreader’, in the attempt to invite people to remain vigilant and follow preventive measures despite the holiday season.⁵⁹ WHO also collaborated with the influencer, author and founder of ‘WeWoreWhat’ and ‘WeGaveWhat’ Danielle Bernstein, who has 2.6 million followers on Instagram, to create a series of interviews discussing COVID-19-related topics.^{60 61} Besides these two examples, WHO has worked with a large number of Instagram influencers and YouTubers to spread accurate information through various channels and reached a wide and diverse audience. Such influencers included Healthcare Triage, Dr Mike and Amoeba Sisters.^{62–64} WHO has also collaborated with YouTube Brazil for the creation of public service announcements to dispel vaccine myths and promote protective behaviours.

TOOLS TO AMPLIFY PUBLIC HEALTH MESSAGES

In addition to approaches that increase access to accurate information and prevent the distribution of COVID-19-related misinformation, falsehoods, myths and conspiracy theories, WHO has created tools to amplify the reach and efficacy of public health messages. For instance, since chatbots have been shown to be very promising tools in public health,⁶⁵ and in particular in promoting healthy lifestyles,⁶⁶ WHO has created the WHO Health

Alert Chatbot to provide information on which safety measures should be maintained and why, how to prevent the disease, what the symptoms are, short-term and long-term effects of the disease, etc.⁶⁷ The WHO Health Alert Chatbot was released in March 2020 and is currently available on WhatsApp, Facebook Messenger and Viber.^{67–70} As of 14 July 2021, the chatbots have reached over 20 million people around the globe and are supported by 20 different languages, including Somali and Kurdish. In fact, the chatbots have been extremely helpful in bringing accessible information to people living in fragile states or with a collapsed healthcare system. For example, in May 2020, 50% of all Arabic users of the WhatsApp chatbot were from Yemen. On 8 March 2021, WhatsApp added the option to receive push notifications. As of 1 July 2021, more than 30 000 subscribers opted in to receive weekly notifications, with 87.9% of users defining the service as excellent or good in a survey launched on 24 June 2021. In order to reach vulnerable people with access to a phone but without access to internet data, WHO also partnered with Facebook and Prækelt.org to provide COVID-19-related health information free of data charges on Discover and Free Basics platforms, reaching over 2.1 million vulnerable people as of 1 July 2021.⁷¹ This service is currently available in more than 50 countries and nine languages, with most users coming from Pakistan, South Africa, USA, Benin and Nigeria.

CONCLUSION

The ongoing infodemic has revealed the devastating effects of misinformation for public health, with its ability to undermine global efforts to solve this unprecedented global crisis. Health messages coming from WHO and other institutions, health professionals, accredited media, journalists and social media influencers can mitigate the danger of misinformation by providing the general public with trustworthy and accurate information concerning COVID-19 and vaccines. Bringing *more* health messages into *more* lives through *more* channels is therefore a priority to counteract the overwhelming number of falsehoods, myths and conspiracy theories circulating online. This proves to be challenging, given that fake news can circulate faster and more effectively than accurate information.⁴ In light of this, WHO organised the work to keep people safe and informed around three main pillars.

First, WHO has been actively promoting evidence-based messages, thus providing accurate health information. Second, WHO has worked with tech companies to pull down misinformation from the internet. Third, WHO—with the support of digital agencies—has created tools, applications and new channels to amplify the reach of trustworthy health information. In fact, in a time of digital information and during a pandemic, a successful public health strategy can no longer rely solely on health organisations’ internal activities. The technological advancements brought forward by the

technology industry have been unprecedented over the past two decades, especially with the advent of artificial intelligence-based tools, with the consolidation of the role played by search engines in providing information globally, and by social media in connecting people and moving information swiftly from person to person. Since the beginning of the COVID-19 pandemic, digital agencies have played an unprecedented role in supporting WHO, adjuvating efforts to keep people informed and safe. WHO's innovative approach has shown that public sector and private corporations can successfully collaborate for the greater good. It has been proposed that a framework of successful collaboration between private and public sectors to strengthen health systems should be based on reputation, team composition, clear goals, shared values and effective communication.⁷² We believe these objectives have been met under the attentive coordination of WHO, through frequent meetings and trust in shared expertise. Under these circumstances, the technology industry has been able to provide solutions to global problems, thus mitigating the misinformation crisis we are living through. Such partnerships have demonstrated that, even between competitors, cooperation can bring positive results for all actors⁷³: people who benefit from accessing accurate information, but also the technology industry itself, with their brands being associated with solidarity and the efforts to solve global crises.

Despite the successes described in this paper, misinformation online currently remains a major obstacle to public health and will likely remain one of the most relevant challenges in the years to come. There is an urgent need to remain vigilant, identify new strategies and maintain an efficient and successful collaboration between all major institutions that have an active role in the decision-making related to global and local health, including national states, digital agencies and health institutions. A global cooperation between these institutions will further strengthen global governance under WHO coordination and guidance, likely serving as a stronger starting point for responses to future crises.

Twitter Federico Germani @fedgermani

Contributors FG organised, wrote and structured the manuscript. FG, ABP and MR edited the manuscript. ABP conceived the idea of the manuscript. ABP and MR provided research field data. FG analysed the data.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests The research and writing work have been financed by the World Health Organization.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Federico Germani <http://orcid.org/0000-0002-5604-0437>

REFERENCES

- World Health Organization. COVID-19 public health emergency of international concern (PHEIC) global research and innovation forum, 2020. Available: [https://www.who.int/publications/m/item/covid-19-public-health-emergency-of-international-concern-\(pheic\)-global-research-and-innovation-forum](https://www.who.int/publications/m/item/covid-19-public-health-emergency-of-international-concern-(pheic)-global-research-and-innovation-forum)
- World Health Organization. Immunizing the public against misinformation, 2020. Available: <https://www.who.int/news-room/feature-stories/detail/immunizing-the-public-against-misinformation>
- Roozenbeek J, Schneider CR, Dryhurst S, *et al*. Susceptibility to misinformation about COVID-19 around the world. *R Soc Open Sci* 2020;7:201199.
- Vosoughi S, Roy D, Aral S. The spread of true and false news online. *Science* 2018;359:1146–51.
- Chou W-YS, Oh A, Klein WMP. Addressing health-related misinformation on social media. *JAMA* 2018;320:2417–8.
- Bridgman A, Merkley E, Loewen PJ, *et al*. The causes and consequences of COVID-19 misperceptions: understanding the role of news and social media. *HKS Misinfo Review* 2020.
- Brennen JSet *al*. Types, sources, and claims of COVID-19 misinformation, reuters institute 2020.
- Germani F, Biller-Andorno N. The anti-vaccination infodemic on social media: a behavioral analysis. *PLoS One* 2021;16:e0247642.
- Hamilton IA. Here's what we know about the bizarre coronavirus 5G conspiracy theory that is leading people to set mobile phone masts on fire, 2020. Available: <https://www.businessinsider.com.au/coronavirus-conspiracy-5g-masts-fire-2020-4?r=US&IR=T>
- Hern A. 5G conspiracy theories fuel attacks on telecom workers, 2020. Available: <https://www.theguardian.com/business/2020/may/07/5g-conspiracy-theories-attacks-telecoms-covid>
- Karić T, Mededović J. Covid-19 conspiracy beliefs and containment-related behaviour: the role of political trust. *Pers Individ Dif* 2021;175:110697.
- Dale D. Fact check: trump wrongly claims FDA 'approved' drug chloroquine to treat the coronavirus, 2020. Available: <https://edition.cnn.com/2020/03/19/politics/fact-check-chloroquine-trump-fda/index.html>
- MacKenzie E. This is how the hydroxychloroquine shortage is hurting people with rheumatoid arthritis, 2020. Available: <https://www.healthline.com/health/rheumatoid-arthritis/hydroxychloroquine-shortage-rheumatoid-arthritis-covid-19>
- Trew B. Coronavirus: hundreds dead in Iran from drinking methanol amid fake reports it cures disease 2020 <https://www.independent.co.uk/news/world/middle-east/iran-coronavirus-methanol-drink-cure-deaths-fake-a9429956.html>
- Wardle C, Singerman E. Too little, too late: social media companies' failure to tackle vaccine misinformation poses a real threat. *BMJ* 2021;372:n26.
- Pattison A. Health and tech must partner to fight vaccine misinformation, 2021. Available: <https://www.devex.com/news/opinion-health-and-tech-must-partner-to-fight-vaccine-misinformation-100116>
- World Health Organization. Coronavirus disease (COVID-19) advice for the public: Mythbusters, 2021. Available: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters>
- Redaelli S. Why celebrities should become science communicators, 2020. Available: <https://culturico.com/2020/01/15/why-celebrities-should-become-science-communicators/>
- Joint statement by WHO, UN, UNICEF, UNDP, UNESCO, UNAIDS, ITU, UN Global Pulse, and IFRC. Managing the COVID-19 infodemic: promoting healthy behaviors and mitigating the harm from misinformation and disinformation, 2020. Available: <https://www.who.int/news/item/23-09-2020-managing-the-covid-19-infodemic-promoting-healthy-behaviours-and-mitigating-the-harm-from-misinformation-and-disinformation>
- Clinical influencers – the medical professionals promoting health on social media, 2021. Available: <https://blogs.bmj.com/bmjopen/2021/05/21/clinical-influencers-promoting-health-on-social-media/>
- World Health Organization. *Managing the COVID-19 infodemic – an ad hoc WHO technical consultation*, 2020.
- Smith N, Graham T. Mapping the anti-vaccination movement on Facebook. *Inform Comm Soc* 2019;22:1310–27.
- Chou C, Tucker C. Fake News and advertising on social media: a study of the anti-vaccination movement. *National Bureau of Economic Research* 2018:25223.

- 24 Evrony A, Caplan A. The overlooked dangers of anti-vaccination groups' social media presence. *Hum Vaccin Immunother* 2017;13:1475-6.
- 25 World Health Organization. Risk communication and community engagement readiness and response to coronavirus disease (COVID-19), 2020. Available: <https://apps.who.int/iris/bitstream/handle/10665/331513/WHO-2019-nCoV-RCCE-2020.2-eng.pdf>
- 26 World Health Organization. *Managing epidemics: key facts about major deadly diseases*, 2018.
- 27 Farr C, Rodriguez S. Facebook, Amazon, Google and more met with WHO to figure out how to stop coronavirus misinformation, 2020. Available: <https://www.cnn.com/2020/02/14/facebook-google-amazon-met-with-who-to-talk-coronavirus-misinformation.html>
- 28 Johnson J. Global market share of search engines 2010-2021. Available: <https://www.statista.com/statistics/216573/worldwide-market-share-of-search-engines/>
- 29 DeSalvo K, Canegallo K. How you'll find accurate and timely information on COVID-19 vaccines, 2020. Available: <https://blog.google/technology/health/accurate-timely-information-covid-19-vaccines/>
- 30 Moxley E. Connecting people with COVID-19 information and resources, 2020. Available: <https://www.blog.google/products/search/connecting-people-covid-19-information-and-resources/>
- 31 Google trends. Available: https://trends.google.com/trends/explore?date=2019-12-01%202021-07-07&q=%2Fm%2F07__7
- 32 De Choudhury M, Ringel Morris M, White RW. Seeking and sharing health information online: comparing search Engines and social media. CHI 2014. April 26 - May 01 2014, Toronto, ON, Canada.
- 33 Al-Dmour H, Masa'deh Ra'ed, Salman A, et al. Influence of social media platforms on public health protection against the COVID-19 pandemic via the mediating effects of public health awareness and behavioral changes: integrated model. *J Med Internet Res* 2020;22:e19996.
- 34 Holmes A. Facebook is launching a new 'coronavirus information center' that will appear at the top of people's news feeds, 2020. Available: <https://www.businessinsider.com/facebook-coronavirus-information-center-news-feed-feature-covid-2020-3?r=US&IR=T>
- 35 COVID-19 information centre. Available: https://www.facebook.com/coronavirus_info
- 36 Rosen G. VP integrity, facebook, an update on our work to keep people informed and limit misinformation about COVID-19, 2020. Available: <https://about.fb.com/news/2020/04/covid-19-misinfo-update/>
- 37 WHO in Yemen. World health organization regional office for the Eastern Mediterranean. Available: <http://www.emro.who.int/yemen/news/public-and-private-sectors-join-forces-to-deliver-lifesaving-covid-19-supplies-in-yemen.html>
- 38 WHO health emergency dashboard. Available: <https://covid19.who.int/region/emro/country/ye>
- 39 Pichai S. COVID-19: \$800+ million to support small businesses and crisis response, 2020. Available: <https://blog.google/inside-google/company-announcements/commitment-support-small-businesses-and-crisis-response-covid-19/>
- 40 Facebook. Available: <https://www.facebook.com/4/posts/10111615249124441/?d=n>
- 41 Wojcicki S. Inside YouTube. Letter from Susan: our 2021 priorities, 2021. Available: <https://blog.youtube/inside-youtube/letter-from-susan-our-2021-priorities/>
- 42 Most popular online dating apps in the United States as of September 2019. Available: <https://www.statista.com/statistics/826778/most-popular-dating-apps-by-audience-size-usa/>
- 43 A message from our CEO: connecting in the time of COVID-19. Available: <https://www.tinderpressroom.com/Connecting-in-the-time-of-COVID-19>
- 44 Skwarczek B. How the gaming industry has leveled up during the pandemic, 2021. Available: <https://www.forbes.com/sites/forbestechcouncil/2021/06/17/how-the-gaming-industry-has-leveled-up-during-the-pandemic/?sh=63536c9f297c>
- 45 Goodman W, McFerran E, Purves R, et al. The Untapped potential of the gaming community: narrative review. *JMIR Serious Games* 2018;6:e10161.
- 46 Limperos AM. Video games and gaming: reaching audiences with health and risk messages. Oxford Research Encyclopedias Communication. 28 June 2017.
- 47 Baranowski T, Frankel L. Let's get technical! Gaming and technology for weight control and health promotion in children. *Childhood Obesity* 2011.
- 48 Twitter. Available: <https://twitter.com/gabrelyanov/status/1338835198285328384>
- 49 Playrix. Playrix, with WHO input, launches Yoga season event for its Gardenscapes online gaming community, 2021. Available: <https://www.prnewswire.com/news-releases/playrix-with-who-input-launches-yoga-season-event-for-its-gardenscapes-online-gaming-community-301269628.html>
- 50 World Health Organization. Experts and gamers join forces to fight COVID-19 and stop future disease outbreaks via Plague Inc, 2021. Available: <https://www.who.int/news-room/feature-stories/detail/experts-and-gamers-join-forces-to-fight-covid-19-and-stop-future-disease-outbreaks-via-plague-inc-the-cure>
- 51 Plague Inc: the cure. Available: <https://www.ndemiccreations.com/en/57-plague-inc-cure>
- 52 Play antidote now! Available: <https://psyongames.com/antidote/>
- 53 World Health Organization. The WHO and angry birds friends encourage communities to stay active during COVID-19, 2021. Available: <https://www.who.int/news/item/26-07-2021-the-who-and-angry-birds-friends-encourage-communities-to-stay-active-during-covid-19>
- 54 Coronavirus: YouTube bans 'medically unsubstantiated' content, 2020. Available: <https://www.bbc.com/news/technology-52388586>
- 55 Facebook. COVID-19 and vaccine policy updates & protections. Available: <https://www.facebook.com/help/230764881494641>
- 56 Gupta S, Dash SB, Mahajan R. The role of social influencers for effective public health communication. *OIR* 2021;8.
- 57 World Health Organization. Stakeholders. Available: <https://www.who.int/about/who-we-are/stakeholders>
- 58 Spitale G, Germani F, Biller-Andorno N. The PHERCC matrix. An ethical framework for planning, governing, and evaluating risk and crisis communication in the context of public health emergencies 2022.
- 59 World Health Organization. New PSA campaign from WHO and YouTube is a playbook for a safe holiday season, 2020. Available: <https://www.who.int/news/item/17-12-2020-new-psa-campaign-from-who-and-youtube-is-a-playbook-for-a-safe-holiday-season>
- 60 Instagram. Available: <https://www.instagram.com/p/CLFYmB7p02b/>
- 61 Instagram. Available: <https://www.instagram.com/tv/CMdBoveHeem/?igshid=1pokxrfhz6bfe>
- 62 Youtube. Available: <https://www.youtube.com/watch?v=h1RRisgcoh0>
- 63 Youtube. Available: <https://www.youtube.com/c/DoctorMike/search?query=world%20health%20organization>
- 64 Youtube. Available: <https://www.youtube.com/watch?v=jeewK7RnswU>
- 65 Gabarron E, Larbi D, Denecke K, et al. What do we know about the use of chatbots for public health? *Stud Health Technol Inform* 2020;270:796-800.
- 66 Fadhil A, Gabrielli S. Addressing challenges in promoting healthy lifestyles: the al-chatbot approach. PervasiveHealth'17: Proceedings of the 11th EAI International Conference on Pervasive Computing Technologies for Healthcare, May 2017:261-5.
- 67 World Health Organization. WHO health alert brings COVID-19 facts to billions via WhatsApp, 2021. Available: <https://www.who.int/news-room/feature-stories/detail/who-health-alert-brings-covid-19-facts-to-billions-via-whatsapp>
- 68 World Health Organization. WHO launches a chatbot on Facebook Messenger to combat COVID-19 misinformation, 2020. Available: <https://www.who.int/news-room/feature-stories/detail/who-launches-a-chatbot-powered-facebook-messenger-to-combat-covid-19-misinformation>
- 69 WhatsApp. The World Health Organization launches WHO health alert on WhatsApp. Available: <https://www.whatsapp.com/coronavirus/who/?lang=en>
- 70 World Health Organization. WHO and Rakuten Viber fight COVID-19 misinformation with interactive chatbot, 2020. Available: <https://www.who.int/news-room/feature-stories/detail/who-and-rakuten-viber-fight-covid-19-misinformation-with-interactive-chatbot>
- 71 World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - 7 July 2020. Available: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-7-july-2020>
- 72 Christie S, Chahine T, Curry LA, et al. The evolution of trust within a global health partnership with the private sector: an inductive framework. *Int J Health Policy Manag* 2021;14. doi:10.34172/ijhpm.2021.14
- 73 Marcelo A. A call to action for Multisectoral coordination on digital health. *Int J Dig Health* 2021;1:28.