A Tale of Two Pandemics: COVID-19 and Misinformation

Richard Stein[1], Oana Ometa[2], Sarah Pachtman[3], Adi Katz[4], Mircea Ionut Popitiu[5], and Robert Brotherton[6]

[1]New York University Tandon School of Engineering
[2]Babes-Bolyai University
[3]Long Island Jewish Medical Center Northwell Health Cancer Institute
[4]Lenox Hill Hospital
[5]University of Medicine and Pharmacy Victor Babes Timisoara
[6]Barnard College, Columbia University

September 28, 2020

Conspiracy theories, omnipresent in traditional and modern societies [1], span demographic strata and political differences [2] and have fascinated people for ages [3]. While many conspiracy theories are harmless and may even be entertaining, the ones related to medical and public health topics can be particularly dangerous for the individual and collective well-being [3]. This second category includes misinformation and conspiracy theories related to COVID-19, which is likely one the most significant pandemics of our lifetime. Compounding the challenges that it opened for the economy, social and political sciences, and biomedical, translational, and clinical research, COVID-19 also propelled discussions about conspiracy theories and media health literacy to the forefront of public health in ways that were nearly impossible to predict.

Situations of crisis, fear, and uncertainty increase the likelihood of conspiratorial thinking [4]. A key difference between COVID-19 and the 1918 flu pandemic, which is sometimes used as a reference, is that a highly interconnected world, to a great extent on social media, is setting the stage for distributing information and misinformation about COVID-19 [5]. In the short time since the beginning of the pandemic, the number of COVID-19-related conspiracy theories increased and propagated on social media. According to some metrics, online sensationalist and conspiratorial sites and articles generate more user engagement than more reputable sources such as the World Health Organization and the US Centers for Disease Control and Prevention [6] or mainstream news media such as the BBC and New York Times [7].

An important way in which misinformation related to COVID-19 differs from misinformation that impacts other health-related topics is its multi-layered nature, in the sense that it concomitantly targets multiple facets of the pandemic. These include misinformation and conspiracies casting doubt on the very existence of the virus, minimizing the value of long-proven preventive strategies, and questioning the safety, efficacy, and potential ulterior motives of a vaccine that is not even available yet, and not sure it will ever be. In the wake of COVID-19, *an ocean of misinformation* [8] that spans all these domains has accumulated faster than for many other health-related topics. As a result, mutually incompatible and contradictory conspiracy theories were sometimes being endorsed and circulated together [9]. Misinformation and disinformation during the pandemic contributed to the demonization of health care workers [10]. As patients avoided hospitals or had difficulties making appointments in the wake of the pandemic, they experienced delays in accessing healthcare for various medical conditions [11-14]. An increased mortality from acute heart disease was reported in several countries [15]. In this context, ambiguous messages about the pandemic endanger the delivery of healthcare in virtually all clinical areas and can place patients at a heightened risk of complications.

Some conspiratorial claims include assertions that COVID-19 is a hoax, arguments that the virus was created artificially [16, 17] and spread on purpose [18] as a bioweapon [19], or allegations that governments are using the emergency situation to pursue their anti-democratic goals [20]. As early as in January 2020, social media stories contained claims that 5G technologies either caused or accelerated the spread of the pandemic [21, 22]. Other conspiracies argued that people in power are taking advantage of the pandemic as a plan to inject microchip quantum-dot spy software and monitor people [8]. Videos or articles perpetuating these theories were viewed by millions of people on social media platforms. Another conspiracy theory, circulating in several languages, claimed that the swab test reaches the back of the nasopharynx and damages the blood brain barrier, and urged people to refuse testing [23, 24]. Yet another conspiracy theory, spread thousands of times on social media, claimed that testing itself infects people with the coronavirus and urged them to refuse testing [23].

The use of face masks has become a passionately debated topic [25, 26], even though many studies support their benefit against SARS-CoV, SARS-CoV-2, MERS-CoV, [27, 28], flu, and seasonal coronaviruses [29]. Some people wearing masks have faced alienation or discrimination [30]. Claims on social media that the virus crosses the masks, and therefore the mask is useless, have been circulating together with claims that the virus persists on the surface of the mask and wearing a mask would, therefore, infect people, or that the mask could "activate the virus" [31]. Other social media claims include warnings that masks may cause fungal or bacterial pneumonia [32] or oxygen deprivation and carbon dioxide poisoning [33], an especially worrisome complication for children and pregnant women, despite evidence that no differences exist in heart rate and oxygen saturation between pregnant and non-pregnant women wearing N95 respirators for a short period of time [34].

Most recently, warnings on social media advised people of the dangers of having their temperature checked upon entering closed spaces, based on the false claim that infrared light damages their pineal gland, when in reality infrared thermometers detect radiation emitted by the body [35, 36]. Other pseudoscientific claims advanced unproven therapies, including homeopathic arsenic-based products or colloidal silver solutions [22], advocated for prophylactic vitamin megadoses [37], promoted vitamin C and garlic as miracle remedies [38], and recommended ginger, hot pepper, and lemon to limit the impact of the pandemic [39].

A vaccine is highly anticipated but not yet available, and it is uncertain which of the several vaccines that are currently pursued will succeed, if any. As of late July 2020, ˜200 vaccine candidates were under active development and 15 were in human clinical trials [40]. Prior to the widespread use of social media and crowdsourcing to obtain medical information and advice, the spread of infectious disease outbreaks was usually limited to confined geographic locations; now, the availability of misinformation widens the footprint of its harm. Vaccine-related misinformation on social media is rampant. In late April 2020, a false story that circulated claimed that one of the first volunteers in the UK during a COVID-19 vaccine trial died from complications [41]. Another conspiracy theory claimed that the vaccine will be used to establish a global surveillance network [42]. Additionally, various social media posts are already providing advice on how to avoid the vaccine. A WebMD poll in late July 2020 found that if a COVID-19 vaccine was available, fewer than one-third of the respondents would take it in the first 90 days, and fewer than one-half of the people would take it in the first year [43].

Each of these conspiracy theories may be destructive in itself. While it is challenging to demonstrate the direct influence of any given conspiracy theory on an individual's behavior, there are some suggestive trends. In the wake of the misinformation linking 5G technologies to the pandemic, attacks were perpetrated against telecommunication masts on several continents, and engineers were subjected to verbal and physical abuse [44]. Between April 2-6, 2020, it was estimated that at least 20 phone masts were damaged in the UK. This included a hospital in Birmingham, UK, whose phone mast was set on fire [21]. There are previous examples to illustrate the heavy price of denial and misinformation in the wake of an infectious disease crisis. During the HIV/AIDS pandemic, claims that the virus does not exist or that it does not cause AIDS were incredibly harmful [38]. When the South African government, in its widely criticized denialist approach [45], withheld lifesaving drugs and promoted non-tested alternative solutions instead [46], the public health damage was

incalculable and estimated to have claimed >330,000 lives [47-49].

Anti-vaccination rhetoric and conspiracies are not new. They existed since Edward Jenner's time, when some rumors claimed that vaccination will make people grow horns [50, 51]. The themes have been strikingly similar across time, and include distrust of the medical establishment or governments mandating vaccination; revulsion at the idea of introducing unknown substances into the body; accusations that the ingredients are harmful; or suspicion that the real motives behind vaccines are to make people sick or to control the population. Like many conspiracy theories, some worries over history have been rooted in a kernel of truth. Such examples include the Tuskegee Syphilis Study, where the government and the medical establishment have abused their power at the cost of people's health [52-54]; the rare cases when contaminated vaccines caused harm [55-57]; or instances when vaccination was used as a cover for intelligence operations [58]. During the Zika virus epidemic, some of the conspiracy theories claimed that the disease was caused by vaccines, and an Australian anti-vaccination Facebook group emphasized that the vaccine used to prevent diphtheria, tetanus, and pertussis in pregnant women was introduced in Brazil only months before the Zika outbreak [59-61]. This makes it understandable, to a certain extent, why some people continue to view vaccines with suspicion.

A paradox in the vaccination debate seems to be the fact that even though vaccines have well-known and widely-reported adverse effects [62-64], most conspiratorial discussions focus on false claims about adverse effects that were never linked to vaccines, while the actual adverse effects, that scientists and regulators are attempting to address and avoid, are rarely discussed, if ever. What makes the COVID-19 vaccine refusal so different is that the debates are directed against a vaccine that was not even manufactured yet. Amidst these multiple layers of misinformation and conspiratorial discourse, the potential for damage is unpredictable, poignant, and difficult to manage, and the challenges associated with bringing the pandemic under control adopt a new, amplified, and more acute perspective.

On the bright side, overall, social media harbors a larger volume of accurate information than misinformation [65]. The sobering news is that misinformation seems to be more popular [65], become more prevalent over time [66], and spread faster, farther, and deeper [67, 68]—though whether this is true of health emergencies is less clear [69]. Several studies found that COVID-19 conspiracy beliefs negatively correlate with COVID-19 health-protective behaviors [70, 71], and individuals who support COVID-19 conspiracy theories are less likely to accept the advice of public health experts [72].

Even though social media made it easier to disseminate misinformation, it is not clear to what extent it causes more people to believe in them. Surveys of public opinion around conspiratorial beliefs, particularly during an ongoing global event such as the current pandemic, should be interpreted with caution. The responses to such surveys depend on the questions asked. As noted, conspiracy theories often make a multitude of specific, sometimes mutually contradictory claims; COVID-19 conspiracy theories are no exception. As a result, it is difficult for a single survey to cover all variants of any given conspiracy theory. While research suggests that endorsement of one conspiracy theory predicts the endorsement of others, general conspiratorial ideation has been found to be relatively weakly predictive of general conspiracy claims about COVID-19, and even more weakly predictive of a plethora of specific claims [71]. Even more basic aspects of survey design such as the wording of available response options can have a substantial influence on responses [73]. The extent to which such surveys over- or underestimate true engagement with conspiracy theories is therefore unknown. It must also be noted that misinformation constitutes only a small fraction of people's news consumption, and that news consumption itself is only a small fraction of people's overall information diet [74]. The nuances of public opinion around conspiracy claims should receive increased attention in the years to come, as they have the potential to directly impact public health.

Even though initial surveys indicate that many people would hesitate to adopt a coronavirus vaccine, it is important not to over-extrapolate, as responses to hypothetical questions may reflect many unstated assumptions and variables. However, the link merits increased focus over the coming months and years. We also need to recognize that hesitancy does not necessarily suggest that someone is a conspiracy theorist, or that they won't actually seek vaccination should it become a reality with demonstrated safety and efficacy.

A lot remains to be understood about people's attitudes towards vaccines, and we should support this topic to further develop in the years to come.

As we are exploring the best way forward during the COVID-19 pandemic, an ongoing challenge and a critical task will be to understand how to limit the rapid spread of misinformation, for which the term "infodemic" was coined to reflect its amplitude and extent [75-77]. Prompt, effective, and targeted interventions that seek to delegitimize misinformation emerge as an important strategy to reduce its impact. It was suggested that social media users should take advantage of the mechanisms available to report misinformation on the respective platforms [21]. More extensive efforts need to be dedicated to advance and promote media and social media literacy, and to interrogate the impact of misinformation, disinformation, and conspiratorial thinking on the different facets of this pandemic and of other public health emergencies. For sure, the road ahead will be long and tortuous.

References

1. van Prooijen J-W, van Vugt M. Conspiracy Theories: Evolved Functions and Psychological Mechanisms. *Perspectives on psychological science : a journal of the Association for Psychological Science* 2018;**13** : 770-88.

2. Miller JM. Psychological, Political, and Situational Factors Combine to Boost COVID-19 Conspiracy Theory Beliefs. *Canadian Journal of Political Science Revue Canadienne De Science Politique* 2020: 1-8.

3. Friedman RA. Why Humans Are Vulnerable to Conspiracy Theories.*Psychiatr Serv* 2020: appips202000348.

4. van Prooijen JW, Douglas KM. Conspiracy theories as part of history: The role of societal crisis situations. *Mem Stud* 2017;**10** : 323-33.

5. Limaye RJ, Sauer M, Ali J et al. Building trust while influencing online COVID-19 content in the social media world. *The Lancet Digital health* 2020; **2** : e277-e8.

6. Mian A, Khan S. Coronavirus: the spread of misinformation. *BMC Medicine* 2020; **18** : 89.

7. Au H, Bright J, Howard PN. Social Media Misinformation about the WHOCoronavirus Misinformation Weekly Briefing 20-04-2020. Oxford Internet Institute. Available at: https://www.oii.ox.ac.uk/covid19?. Last accessed on August 26, 2020. 2020.

8. Ball P, Maxmen A. The epic battle against coronavirus misinformation and conspiracy theories. *Nature* 2020; **581** : 371-4.

9. Miller JM. Do COVID-19 Conspiracy Theory Beliefs Form a Monological Belief System? *Canadian Journal of Political Science Revue Canadienne De Science Politique* 2020: 1-8.

10. McKay D, Heisler M, Mishori R et al. Attacks against health-care personnel must stop, especially as the world fights COVID-19.*Lancet (London, England)* 2020; **395** : 1743-5.

11. Lazzerini M, Barbi E, Apicella A et al. Delayed access or provision of care in Italy resulting from fear of COVID-19. *The Lancet Child & adolescent health* 2020; **4** : e10-e1.

12. Dawoud SEB, Kent P, Ho MWS. The impacts of lockdown during the SARS-CoV-2 pandemic on patients presenting with Cervicofacial infection of Odontogenic origin: A Comparative Study. *The British Journal of Oral & Maxillofacial Surgery* 2020.

13. Otero D, Singam NSV, Barry N et al. Complication of Late Presenting STEMI Due to Avoidance of Medical Care During the COVID-19 Pandemic.*JACC Case reports* 2020; **2** : 1610-3.

14. Solis E, Hameed A, Brown K et al. Delayed emergency surgical presentation: impact of corona virus disease (COVID-19) on non-COVID patients. *ANZ journal of surgery* 2020: 10.1111/ans.16048.

15. Mauro V, Lorenzo M, Paolo C, Sergio H. Treat all COVID 19-positive patients, but do not forget those negative with chronic diseases.*Internal and emergency medicine* 2020; **15** : 787-90.

16. Desta TT, Mulugeta T. Living with COVID-19-triggered pseudoscience and conspiracies. *International journal of public health* 2020: 1-2.

17. Imhoff R, Lamberty P. A Bioweapon or a Hoax? The Link Between Distinct Conspiracy Beliefs About the Coronavirus Disease (COVID-19) Outbreak and Pandemic Behavior. *Social Psychological and Personality Science* 2020: 1948550620934692.

18. Uscinski JE, Enders AM, Klofstad CA et al. Why do people believe COVID-19 conspiracy theories? *The Harvard Kennedy School (HKS) Misinformation Review https://doiorg/1037016/mr-2020-015* 2020.

19. Larson HJ. Blocking information on COVID-19 can fuel the spread of misinformation. *Nature* 2020; **580** : 306.

20. Oleksy T, Wnuk A, Maison D, Łyś A. Content matters. Different predictors and social consequences of general and government-related conspiracy theories on COVID-19. *Personality and Individual Differences* 2021; **168** : 110289-.

21. Ahmed W, Vidal-Alaball J, Downing J, López Seguí F. COVID-19 and the 5G Conspiracy Theory: Social Network Analysis of Twitter Data. *J Med Internet Res* 2020; **22** : e19458.

22. Naeem SB, Bhatti R, Khan A. An exploration of how fake news is taking over social media and putting public health at risk. *Health Info Libr J* 2020.

23. Goodman J, Carmichael F. Coronavirus tests: Swabs don't damage the brain and other claims fact-checked. Available at: https://www.bbc.com/news/53443429. Last accessed on August 8, 2020. 2020.

24. Staff R. Fact check: Coronavirus tests do not cause brain damage or plant substances on the brain. *Available at: https://wwwreuterscom/article/uk-factcheck-swabs/fact-check-coronavirus-tests-do-not-cause-brain-damage-or-plant-substances-on-the-brain-idUSKCN24G2NL Last accessed September 26, 2020* 2020.

25. Godoy M. Yes, Wearing Masks Helps. Here's Why. Available at: https://www.npr.org/sections/health-shots/2020/06/21/880832213/yes-wearing-masks-helps-heres-why. Last accessed on August 6, 2020. 2020.

26. Reynolds E. The mask debate is still raging in the US, but much of the world has moved on. Available at: https://www.cnn.com/2020/07/21/europe/masks-debate-us-europe-asia-intl/index.html. Last accessed on August 8, 2020. 2020.

27. Chu DK, Akl EA, Duda S et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *The Lancet*2020; **395** : 1973-87.

28. Wang Y, Tian H, Zhang L et al. Reduction of secondary transmission of SARS-CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China. *BMJ Glob Health*2020; **5** .

29. Leung NHL, Chu DKW, Shiu EYC et al. Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nature Medicine* 2020;**26** : 676-80.

30. Chan DKC, Zhang C-Q, Weman-Josefsson K. Why people failed to adhere to COVID-19 preventive behaviors? Perspectives from an integrated behavior change model. *Infection control and hospital epidemiology* 2020: 1-2.

31. McGreal C. A disgraced scientist and a viral video: how a Covid conspiracy theory started. Available at: https://www.theguardian.com/world/2020/may/14/coronavirus-viral-video-plandemic-judy-mikovits-conspiracy-theories. Last accessed on August 29, 2020. 2020.

32. Oswald B. Facts Matter: Pneumonia not caused by wearing face mask*Available at: https://wwwdailyheraldcom/news/20200704/facts-matter-pneumonia-not-caused-by-wearing-face-mask, Last accessed September 7, 2020* 2020.

33. Forster V. Doctors On Twitter Prove Masks Are Safe During The Coronavirus Pandemic By Measuring Their Oxygen Levels. Available at: https://www.forbes.com/sites/victoriaforster/2020/07/01/twitter-doctors-prove-masks-are-safe-during-the-coronavirus-pandemic-by-measuring-their-oxygen-levels/#2e353456d013. Last accessed September 7, 2020. 2020.

34. Roeckner JT, Krstić N, Sipe BH, Običan SG. N95 Filtering Facepiece Respirator Use during Pregnancy: A Systematic Review. *Am J Perinatol* 2020; **37** : 995-1001.

35. Swenson A. Infrared thermometers used for COVID-19 testing do not pose risk to pineal gland. Available at: https://apnews.com/afs:Content:9121703294. Last accessed on August 9, 2020. 2020.

36. Chen H-Y, Chen A, Chen C. Investigation of the Impact of Infrared Sensors on Core Body Temperature Monitoring by Comparing Measurement Sites. *Sensors (Basel, Switzerland)* 2020; **20** : 2885.

37. López C, Miller AM. Wellness influencers are telling followers potentially toxic doses of vitamins will protect them from the coronavirus. Available at: https://www.businessinsider.com/wellness-influencers-say-near-lethal-vitamin-doses-prevent-coronavirus-2020-2. Last accessed on September 7, 2020. 2020.

38. Mian A, Khan S. Coronavirus: the spread of misinformation. *BMC medicine* 2020; **18** : 89-.

39. Desta TT, Mulugeta T. Living with COVID-19-triggered pseudoscience and conspiracies. *Int J Public Health* 2020: 1-2.

40. Chugh T. Timelines of COVID-19 Vaccines. *Current Medicine Research and Practice* 2020.

41. Megget K. Even covid-19 can't kill the anti-vaccination movement.*BMJ* 2020; **369** : m2184.

42. Hotez PJ. COVID19 meets the antivaccine movement. *Microbes and infection* 2020; **22** : 162-4.

43. Crist C. WebMD Poll: Most Would Wait on COVID Vaccine. Available at: https://www.webmd.com/lung/news/20200728/webmd-covid-vaccine-poll. Last accessed on August 7, 2020. 2020.

44. Jolley D, Paterson JL. Pylons ablaze: Examining the role of 5G COVID-19 conspiracy beliefs and support for violence. *Br J Soc Psychol* 2020; **59** : 628-40.

45. Cohen J. South Africa. AIDS researchers decry Mbeki's views on HIV.*Science* 2000; **288** : 590-1.

46. Chigwedere P, Seage GR, 3rd, Gruskin S et al. Estimating the lost benefits of antiretroviral drug use in South Africa. *J Acquir Immune Defic Syndr* 2008; **49** : 410-5.

47. Bateman C. Paying the price for AIDS denialism. *S Afr Med J*2007; **97** : 912-4.

48. Simelela N, Venter WD, Pillay Y, Barron P. A Political and Social History of HIV in South Africa. *Curr HIV/AIDS Rep* 2015;**12** : 256-61.

49. Nattrass N. AIDS and the Scientific Governance of Medicine in Post-Apartheid South Africa. *African Affairs* 2008; **107** : 157-76.

50. Andrade G. Medical conspiracy theories: cognitive science and implications for ethics. *Medicine, health care, and philosophy*2020: 1-14.

51. Andrade GE, Hussain A. Polio in Pakistan: Political, Sociological, and Epidemiological Factors. *Cureus* 2018; **10** : e3502-e.

52. Corbie-Smith G, Thomas SB, Williams MV, Moody-Ayers S. Attitudes and beliefs of African Americans toward participation in medical research.*J Gen Intern Med* 1999; **14** : 537-46.

53. Thomas SB, Quinn SC. The Tuskegee Syphilis Study, 1932 to 1972: implications for HIV education and AIDS risk education programs in the black community. *Am J Public Health* 1991; **81** : 1498-505.

54. Gamble VN. Under the shadow of Tuskegee: African Americans and health care. *Am J Public Health* 1997; **87** : 1773-8.

55. Group A streptococcal abscesses after DTP immunization–Georgia.*MMWR Morb Mortal Wkly Rep* 1982; **31** : 519-20, 25-6.

56. Stetler HC, Garbe PL, Dwyer DM et al. Outbreaks of group A streptococcal abscesses following diphtheria-tetanus toxoid-pertussis vaccination. *Pediatrics* 1985; **75** : 299-303.

57. Lahariya C. A brief history of vaccines & vaccination in India.*The Indian journal of medical research* 2014; **139** : 491-511.

58. McCarthy M. US will no longer use vaccination programs as cover for spy operations, White House says. *BMJ : British Medical Journal*2014; **348** : g3494.

59. Klofstad CA, Uscinski JE, Connolly JM, West JP. What drives people to believe in Zika conspiracy theories? *Palgrave Communications*2019; **5** : 36.

60. Specter M. The Dangerous Conspiracy Theories About the Zika Virus. Available at: https://www.newyorker.com/news/daily-comment/the-dangerous-conspiracy-theories-about-the-zika-virus. Last accessed on September 7, 2020. 2016.

61. Sullivan R. Health experts slam anti-vaxxers' zika virus conspiracy theory as 'absurd'. Available at: https://www.news.com.au/lifestyle/real-life/news-life/health-experts-slam-antivaxxers-zika-virus-conspiracy-theory-as-absurd/news-story/a53d0aaa03cc73922916cd63143bff6e. Last accessed on September 7, 2020. 2016.

62. Spencer JP, Trondsen Pawlowski RH, Thomas S. Vaccine Adverse Events: Separating Myth from Reality. *Am Fam Physician* 2017; **95** : 786-94.

63. Staltari O, Cilurzo F, Caroleo B et al. Annual report on adverse events related with vaccines use in Calabria (Italy): 2012.*Journal of pharmacology & pharmacotherapeutics* 2013; **4** : S61-S5.

64. Committee to Review Adverse Effects of V, Institute of M. In: Stratton K, Ford A, Rusch E, Clayton EW, eds. *Adverse Effects of Vaccines: Evidence and Causality* . Washington (DC): National Academies Press (US)

Copyright 2012 by the National Academy of Sciences. All rights reserved. 2011.

65. Wang Y, McKee M, Torbica A, Stuckler D. Systematic Literature Review on the Spread of Health-related Misinformation on Social Media.*Social science & medicine (1982)* 2019; **240** : 112552-.

66. Wang Y, McKee M, Torbica A, Stuckler D. Systematic Literature Review on the Spread of Health-related Misinformation on Social Media.*Soc Sci Med* 2019; **240** : 112552.

67. Vosoughi S, Roy D, Aral S. The spread of true and false news online.*Science* 2018; **359** : 1146-51.

68. Tasnim S, Hossain MM, Mazumder H. Impact of Rumors and Misinformation on COVID-19 in Social Media. *Journal of preventive medicine and public health = Yebang Uihakhoe chi* 2020; **53** : 171-4.

69. Pulido C, Villarejo B, Redondo-Sama G, Gomez A. COVID-19 infodemic: More retweets for science-based information on coronavirus than for false information. *International Sociology* 2020: 026858092091475.

70. Allington D, Duffy B, Wessely S et al. Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. *Psychol Med* 2020: 1-7.

71. Freeman D, Waite F, Rosebrock L et al. Coronavirus conspiracy beliefs, mistrust, and compliance with government guidelines in England.*Psychol Med* 2020: 1-13.

72. Motta M, Stecula D, Farhart C. How Right-Leaning Media Coverage of COVID-19 Facilitated the Spread of Misinformation in the Early Stages of the Pandemic in the U.S. *Canadian Journal of Political Science Revue Canadienne De Science Politique* 2020: 1-8.

73. Sutton RM, Douglas KM. Agreeing to disagree: reports of the popularity of Covid-19 conspiracy theories are greatly exaggerated.*Psychological Medicine* 2020: 1-3.

74. Allen J, Howland B, Mobius M et al. Evaluating the fake news problem at the scale of the information ecosystem. *Science Advances* 2020;**6** : eaay3539.

75. Naeem SB, Bhatti R. The Covid-19 'infodemic': a new front for information professionals. *Health information and libraries journal* 2020: 10.1111/hir.12311.

76. The Lancet Infectious D. The COVID-19 infodemic. *The Lancet Infectious diseases* 2020; **20** : 875-.

77. Chong YY, Cheng HY, Chan HYL et al. COVID-19 pandemic, infodemic and the role of eHealth literacy. *International journal of nursing studies* 2020; **108** : 103644-.