Global Journal of Medicine & Public Health

The COVID-19 infodemic: the role and place of academics in communicating science to the public

*Jennifer Cole **

ABSTRACT

As the COVID-19 pandemic has spread across the world, a concurrent pandemic of information has spread with it. This has been deemed an 'infodemic' by the World Health Organization. Defined as an overabundance of information – some accurate, some not – that occurs during an epidemic, this proliferation of data, research and opinions provides opportunities and challenges. Academics and scientists have a key role to play in infodemics: as educators, influencers and communicators, their insights are of great value to public discussion even though they too are experiencing SARS-Cov2 and COVID-19 for the first time.

Successful communication requires a deeper understanding of how the public seeks, understands and processes scientific information in order to maximize experts' engagement with traditional and social media. Such engagement must not add to confusion and misinformation alongside efforts to challenge it. This paper outlines the key advantages to be had from greater engagement with public COVID-19 discussions, identifies popular channels through which such discussions take place and describes how information is disseminated through them. Common pitfalls are identified but these are far outweighed by the benefits of such engagement.

GJMEDPH 2020; Vol. 9, issue 2
***Corresponding Author**
Jennifer Cole
Department of Geography
Royal Holloway, University of London,
Egham Hill, Egham, Surrey TW20 0EX,
United Kingdom
jennifer.cole@rhul.ac.uk

Conflict of Interest—none

Funding—none

Keywords: Infodemic, COVID-19, Health communication, Risk communication, Pandemics

INTRODUCTION

As the COVID-19 pandemic has spread across the world, a concurrent pandemic of information has spread with it.[1] Deemed an 'infodemic' by the World Health Organization (WHO) and described as, "an overabundance of information, some accurate, some not, that occurs during an epidemic"[2] this proliferation of data, research and opinions provides opportunities and challenges. Scientists and academics have key roles to play in the solutions to these challenges. In March 2020, WHO Director-General Tedros Adhanom Ghebreyesus called for the need to manage the COVID-19 infodemic.[3] In approaching this challenge, there has been a tendency to focus predominantly on the misinformation and disinformation that spreads through informal rumour networks, social media platforms and traditional media,[4] however, and to overlook the opportunities these channels can also offer. This unfettered flow of information presents opportunities for embracing knowledge exchange and dissemination but taking full advantage of this requires a better understanding of the ways in which that information is exchanged. This, in turn, is dependent on understanding how the information fits with and into communicative ecologies – the socio-cultural framing and analysis of the local context in which communication occurs and which shapes its meaning.[5] The available opportunities are particularly important to embrace as, in the digital age, information can spread across the world and through populations even more quickly than viruses.[6] Public health messages that can help with disease prevention and control can be disseminated quickly, as can messages that will counter misinformation before it is able to take hold. Information – both good and bad – spreads through populations in similar ways and through similar mechanisms to the spread of

disease[7] potentially offering opportunities to ensure information on protective behaviours reaches at-risk populations ahead of the virus. WHO has identified five key roles in infodemic management: scan and verify evidence; explain the science; amplify the reach of messages; measure the infodemic and assess trends and impacts; and coordinate and govern information technology.[1] As a key stakeholder in the production, interpretation and dissemination of knowledge, academics have a particularly important part to play in the first three of these roles.

People enjoy sharing information: the role of social diffusion in information spread is well documented.[8,9] However, this holds true even when an individual does not believe the information they are sharing to be true.[10] Disinformation (information passed on maliciously when it is known to be false, leading to a defective information process[11]) and misinformation (false information shared in the mistaken belief that it is valid[12]) far predate social media.[13] As far back in history as the Black Death of the 14th century, false information abounded. Rumours included, for example, accusations that the disease was due to Jews poisoning wells and streams.[14] Fake news has been disseminated through a wide variety of media across centuries of political history[15] – including many U.S. elections[16]. Its presence on the internet is nothing new: rumours and falsehoods spread through whatever media people use to communicate, be this verbal, written, broadcast or digital. So too does the reliable information that can counter, correct and complete those falsehoods – as long as those who hold better information can mobilize themselves quickly and efficiently and are willing to do so.

Early pioneers of communication science talked of communication as bits of information whose flow could be quantified between sender(s) and receiver(s).[17] Since the earliest days of the internet, academics have considered the importance of focussing on the social construction of knowledge as well as its content.[18] More than 30 years ago, Pierre Lévy wrote about the internet as a new kind of knowledge space[19] – as transformative to knowledge flows as the development of language, notation such as writing, mathematics and cartography, and the invention of printing – but he also warned that the key challenge for humanity in the computer age is to understand how to order and process this knowledge, so that we do not simply "haul masses of information around with us" (p10). We should be heedful of this during the current pandemic. By the end of December 2020, there were more than 85,000 academic publications on COVID-19 indexed on PubMed (not including pre-prints), with new ones appearing every day – many of which attract interest from lay public and media as well as the academy. Cyberspace is an enabler that allows for the discovery, publication and application of new knowledge, the dissemination of best practices and information, and the exchange of views and opinions. It thus creates economic opportunities and a more educated workforce.[20] On the negative side, the internet also enables the spread of fake news,[21] conspiracy theories[22] and misinformation,[23] though often not to as great an extent as is assumed.[24,25] In this paper, I focus on four key ways in which the academic community can help to combat the COVID-19 infodemic: by understanding what information people are looking for and where they look for it; by realizing that even an imperfect response may be the best available; by considering how non-academics receive information; and finally by engaging with traditional and social media to deliver appropriate information on the platforms people are most likely to use.

Understand what information people want

During a public health emergency, people seek out more information, more actively, and from more sources, than they did beforehand[26] in order to better understand the situation and the risks it poses to them. People will want to learn as much as they can about a new disease – something which academics, as educators, can certainly help with. Academics fulfil many of the requirements for source credibility that helps information to be believed and acted on.[27] Dashboards that track location, numbers and rate of increase of cases in close to real time have proved particularly popular during COVID-19 and previous disease outbreaks. Examples include the COVID-19 Dashboard produced by Johns Hopkins University,[28] and Worldometer[29] as well as dashboards presenting future projections, for example the Institute of Health

Metrics and Evaluation (IHME).[30] Academic institutions, particularly those that already monitor and collect population health data, are ideally placed to create such data trackers quickly, ensure they are populated with accurate information and to update them regularly as soon as new information is available. How people process such information, differs, however: some prefer to read and self-educate, while others prefer to ask questions and discuss answers in a more socially interactive environment.[31,32] People can struggle to process complex concepts; they may be insufficiently practiced at critical thinking[33] and vulnerable to taking sensational newspaper headlines at face value.[34] As a result, academics and experts should consider not only what information they provide, but also how to explain it clearly – particularly to those who may not have a good grounding in basic science or mathematics – and how to disseminate it across many platforms simultaneously, including those with which academics may be less familiar. To be effective, the message needs to be tailored to the communicative ecology of the population that will read it and be appropriate to the current context.

To reach people who prefer to learn by discussion and interaction, responding to FAQs (frequently asked questions, or question and answer sessions) on popular platforms, including TV shows, radio shows, newspapers and websites can be highly beneficial. The desire to ask questions increases the closer the risk comes and the more immediate to themselves an individual perceives the risk to be.[26] The granularity of the answers required also increases with closeness of risk. Academics contributing to FAQ sessions can enable more context-specific questions to be answered – regarding the risks associated with certain types of workplace,[35] for example, or the risks to those with certain underlying health conditions. Identifying platforms through which such engagement can be provided, including university websites, popular radio shows, AMA (Ask Me Anything) sessions on platforms such as www.reddit.com or in local newspapers will help academics to engage with a variety of communities. Academics may also be able to anticipate what questions community members will benefit from having answered but may not initially think to ask[36] and can provide explanations of terms and data that may not be easily understood[27] or which may have been widely misunderstood. Previous research has shown that people rarely consult only one source of information: most consult several sources, across many different platforms, and are most likely to accept information when multiple sources agree.[27] They are more likely to turn first to familiar platforms they already use and trust, and only look further if these do not provide the information they require. As most laypeople do not routinely check university websites, this may require academics to actively seek out trusted disseminators and go to the platforms the public use (e.g. by setting up a Twitter account), rather than expect the public to come to them. In doing this, is it worth considering that media – whether traditional or social – is neither 'good' nor 'bad', high quality nor low: each medium is unique and shaped by the information it mediates. The better the quality of the information it is given, the better the quality of the information it can disseminate. When individuals evaluate multiple sources, they do not see 'social media' as a single source of information but differentiate between messages that come from friends and family and those from official sources and expert voices.[37] It is worth being mindful that while scientists are widely trusted to understand the facts,[38] the public may have less confidence in their ability to make political decisions based on these facts.[39] It may help academics to consider what type of expert the public will consider them to be to in order to ensure the opinions they express carry the most weight.

Be prepared to step outside of your comfort zone (but not too far)

A second consideration when engaging with traditional or social media – and perhaps in apparent contradiction to the points made above – is that academic research generally moves slowly and can take years to publish. Research findings are presented to the expert community only after rigorous checking and re-checking of evidence. Academics generally only share and discuss their research once they are sure it is accurate. During a fast-moving event such as the COVID-19 pandemic, however, no-one may have the equivalent expertize of a scientist who has spent a lifetime studying influenza or HIV or malaria. The best guess of an expert virologist, even if they are not an

expert SARS-Cov2 virologist, may be the best option available (not least because any true SARS-Cov2 expert virologists may be far too busy applying that expertise to speak to the press or engage with social media). Do not be afraid to offer what expertise you have. This can be uncomfortable for academics but conspiracy theorists,[40] anti-vaccination lobbyists,[41] lockdown sceptics[42] and mask opposers[43] will not show the same restraint. Misinformation thrives in a vacuum. During a fast-moving pandemic the luxury of waiting until one is 100 per cent sure before publishing a proof or discussing a hypothesis does not exist.

WHO infodemic training leans heavily on Voltaire's famous aphorism, already popular within healthcare: "don't let perfect be the enemy of the good."[44] An academic may not know everything, but they will know enough to help the public to understand which mutations may change the game, and which won't; why case fatality rate estimates are likely to be much higher at the start of an epidemic than once better data becomes available; and why vaccine trials often pause for additional safety checks. Be prepared to say what you do know, even if it's not everything, and to explain why uncertainty at stages of a scientific process does not indicate failure. When a single expert is not available, the next best option is to ask a crowd[45] that can formulate a 'best guess' answer between its constituent members, drawing together their 'distributed' intelligence[19] to build consensus and agreement across a variety of sources.[46,47] This method was widely used during the Cold War, when the RAND Corporation developed the Delphi Method,[48] a means by which an expert group – all of whom knew part of the answer – could collate and consolidate that knowledge when considering how the world might react to a nuclear strike.

During the 2014-15 West Africa Ebola outbreak, people expressed frustration when there was a delay in the release of information and updates from official sources.[31] They would quickly turn to less trusted options to fill the gap – but would back-check this against sources they considered to be more reliable later, when information did become available through those sources.[26] A guess from an expert is more likely to be correct than one from a non-expert but it is only available if the expert is prepared to make it. Management theory encourages people to make decisions quickly but to be brave enough to retract and change that decision later if necessary[49]: academics who are less used to operating at such pace may have a lot to learn from fields where such practices are commonplace. Another lesson, from development studies, is how to present, evaluate and decide between a number of sub-optimal options when the most preferred choice is not available.[50] If you are not sure, no-one else may be either. Be willing to share what you do know. Even if it is incomplete and uncertain, it may be the best available.

Consider how research findings will be interpreted

During a pandemic, interest in science and scientific publications increases dramatically. People want to know where the virus came from, how it spreads – modes of transmission and the influence of human behaviour – and will discuss what they think governments should be doing about it. Newspapers and television channels become much more interested in interviewing academics and highlighting their research. When sharing knowledge, however, consider how academic studies and findings could be received by a non-academic audience. There is considerable value in producing plain language summaries for journalists and the public[1] to prevent information from being misinterpreted. It is also important to anticipate what questions people are asking each other,[36] as these may be different to the ones scientists are most interested in answering.

In April 2020, researchers from The Netherlands and Belgium caused much concern by sharing findings that suggested aerosolized particles breathed out by joggers and cyclists infected with COVID-19, if caught in their slipstream, had the potential to spread further than the 1.5m recommended for social distance.[51] The paper (which had not been peer reviewed, but few non-academics fully understand this process) did not suggest that this increased infection risk for any pedestrians these cyclists and joggers passed, simply that some viral particles being carried that far is not impossible. However, the paper was interpreted by the media to mean that people who were passed on the street by an unmasked cyclist or jogger were likely

to become infected. Professor Bert Blocken, the lead author, admitted he had not expected the attention the paper attracted, nor anticipated that a study on particle aerodynamics would be interpreted as being about infection risk.[52] Similarly, articles on small mutations of the SARS-Cov2 virus have been sensationalized in the media, with inference that these will be more deadly. To the average member of the public, the term 'mutant' brings forth images of science-fiction monsters, requiring the science journal *Nature* to print an article debunking this view.[53] Explaining that such mutations are routine and not necessarily cause for alarm can help to dispel misinformation before it takes hold, and needs to be factored into research presentations at the time they are originally discussed. Before speaking to the press, academics need to think like a journalist: how could their work be sensationalized? What conclusions might a member of the public jump to? Academics need to make sure, in presenting the research, that such misinterpretations are headed off.

The same is true of forward projections – a term deliberately preferred in academic and policy research to 'predictions'. Projections tend to present a range of possible outcomes, the high-end of which is generally the situation that is likely arise only if no mitigation efforts are taken. The lower bound of such predictions may represent the more likely outcome, with the reports in which the data are presented providing the roadmap of how to achieve this. Once again, however, it is the high estimates from such data that are more likely to be picked up by the media and presented as what will happen, with the mitigating strategies that should prevent these outcomes being overlooked. In her report to the UK Government on the country's response to the 2009 H1N1 Swine Flu pandemic, Dame Diedre Hine warned that projections do not predict the future and that this needs to be borne in mind whenever such projections are discussed.[54]

Engage with the media to help explain your own and others' findings to the non-academy

Spelling out the ways in which research and scientific data can be misinterpreted by the media and the public may seem counter-intuitive in a paper that is calling for more engagement between academics and both traditional and social media, but in essence it is a modern-day version of the famous military mantra "know your enemy"[55] – in this case, not the SARS-Cov2 virus, but the channels and mediums through which misinformation about it might spread, perhaps more quickly than the virus itself,[56] and the science (il)literacy of the receiving reader. WHO infodemic management training starts from the position that interventions and messages must be based on science and evidence, and must reach citizens if they are to enable them to make informed decisions on how to protect themselves and their communities in a health emergency.[1] Scientists and public health professionals have a duty, in times of uncertainty and fast-moving information, to help those less able to navigate the information flowing over them, to make complex science clearer, and to take the time and effort to anticipate, avoid and correct misunderstandings.[57]

It would be unfair, however, to suggest that this is not without challenges: not only can taking a stance for science be time consuming but also frustrating. In 2016, Dr Phil Williamson, a marine scientist at the University of East Anglia UK, objected to articles published in the politically-motivated *Breitbart News* and *The Spectator* that refuted marine scientists' work on the links between climate change and ocean acidification. He called on fellow scientists to not only communicate more widely but also to correct misinformation and errors where necessary.[57] Frustratingly, he lost an official complaint to the press commission and was openly attacked by the *Breitbart* journalist who wrote the original story.[58] Nonetheless, Williamson stands by the importance of speaking up against such anti-science. Increasingly, academic journals are encouraging health professionals and researchers to do the same, particularly against politicians who deny and denigrate science.[59,60] News agencies such as the UK's Science Media Centre[61] are connecting more responsible media outlets with scientists and researchers who are happy to engage with them, building bridges and encouraging more accurate reporting, from which everyone benefits. Such initiatives are dependent on the cooperation of academics and scientists who are prepared to give their time and build relationships with media agencies, journalists and media platforms.

Fill information vacuums with better information

Academics and scientists who are reluctant to have their words mediated by a journalist can also communicate directly with the public, through social media channels. During COVID-19, there have been many successful examples of this, including epidemiologist Dr Trevor Bedford who engages on Twitter,[62] Dr John Campbell on YouTube,[63] and the moderator team of the r/coronavirus discussion forum on www.reddit.com[64] most of whom are research scientists, medical professionals and academics in fields including virology, epidemiology, paediatrics, public health and biosafety.

Recognizing the opportunities social media offers for challenging misconceptions is particularly valuable: misinformation can be challenged directly, providing platform users with better information to challenge things they see elsewhere, while the voting systems on websites such as reddit act as a form of quality control. Previous research has shown that such voting mechanisms do improve the quality of information and ensure that the better information rises to the top on platforms where information is peer-curated.[25]

When engaging, it is important to understand the source of the misinformation and how it has arisen: a concerned citizen may think they are genuinely uncovering facts others are trying to hide. They may be open to explanations from scientists who understand how novel viruses emerge, biosecurity experts who understand how difficult it would be to manufacture a biological weapon and political scientists who see no immediate motive for doing so.[65,66] They may be prepared to change their stance once things have been explained. It is important for such experts to see the value in debunking rather than simply ignoring or removing such information. A good example of this is the response to a preprint posted on the academic archiving site *BioRxiv* on 1 Feb 2020,[67] which implied that the SARS-Cov2 virus had characteristics suggestive of artificial origin. Speculation on this on the popular online platform reddit[68] was quashed not only by the reddit community itself, but also by the forum's moderator team, a number of whom were research scientists and thus were able to post an informed response.[69] The moderator team recruited two additional moderators from amongst other scientists who engaged with the discussion to debunk the original paper.

Young people in particular may benefit from seeing such discussions played out: they tend to be exposed to a wider range of viewpoints online and do undertake critical fact-checking rather than accepting what they see at face value. Heightened literacy and better understanding of the issues helps such readers to think critically and to make informed decisions on what they read. Knowledge claims are validated between different platforms and audiences. Conflicts between populist and expert opinion are unavoidable; the issue is how competing claims are mediated.[15] This can have particular value where misinformation is coming from a source that should be trusted – such as outgoing U.S. President Donald Trump, who was identified as the key source of online misinformation during the COVID-19 pandemic in a study undertaken by Cornell University.[70]

CONCLUSIONS

We are living in an interconnected world in which the infodemic recognizes no boundaries.[1] Many scientists and academics have already risen to the challenge, making suggestions of how to fight it,[71] producing frameworks for action[1] and undergoing WHO training in infodemic management.[72] Leading academics[60] and entire academic journals[73] have taken a political stance against the misinformation spread by Donald Trump, stressing the greater value of Joe Biden's pro-science approach to the pandemic. Whether this had an impact on the U.S. election results or not, it certainly signalled to the U.S. public who the scientists and academics thought was best placed to steer their country through the most serious pandemic of our lifetime. Every academic has a similar role to play. All of us are educators. We work with evidence and facts, shape them into knowledge and send that knowledge out into the world where it changes lives, shapes the future and empowers others. The way knowledge is collected, discussed, shaped, stored, disseminated, and accessed has evolved. Academics and scientists must evolve with it. We must ride the infodemic wave so that, just as with the COVID-19 pandemic itself, we are able to stay ahead of, and flatten, its curve.

REFERENCES

1. Tangcharoensathien V, Calleja N, Nguyen T, Purnat T, D'Agostino M, Garcia-Saiso S, Landry M, Rashidian A, Hamilton C, AbdAllah A, Ghiga I. Framework for managing the COVID-19 infodemic: methods and results of an online, crowdsourced WHO technical consultation. Journal of Medical Internet research. 2020;22(6):e19659.
2. Coronavirus disease 2019 (COVID-19) situation report – 86. World Health Organizaton. 2020 Apr 15. Available from: http://www.who.int/docs/default-source/coronaviruse/situation-reports/20200415-sitrep-86-covid-19.pdf?sfvrsn=c615ea20_6 [accessed 2020-11-18]
3. Risk communication and community engagement readiness and response to coronavirus disease (COVID-19): interim guidance, 19 March 2020. WHO. Available from: https://www.who.int/publications-detail/risk-communication-and-community-engagement-readiness-and-initial-response-for-novel-coronaviruses-(-ncov) [accessed 2020-11-18]
4. Wardle, C., and Hossein D. Thinking about 'information disorder': formats of misinformation, disinformation, and mal-information. In: Ireton, Cherilyn; Posetti, Julie (Eds). Journalism, 'fake news'& disinformation. Paris: UNESCO(2018): 43-54.
5. Hearn, G.N. and Foth, M., 2007. Communicative ecologies: Editorial preface. Electronic Journal of Communication, 17(1-2).
6. Funk, S. and Jansen, V.A., 2013. The talk of the town: modelling the spread of information and changes in behaviour. In: Modeling the interplay between human behavior and the spread of infectious diseases (pp. 93-102). Springer, New York, NY.
7. Kucharski, A., 2016. Study epidemiology of fake news. Nature, 540(7634), pp.525-525.
8. Bakshy, E., Rosenn, I., Marlow, C. and Adamic, L., 2012, April. The role of social networks in information diffusion. In Proceedings of the 21st international conference on World Wide Web (pp. 519-528).
9. Guille, A., Hacid, H., Favre, C. and Zighed, D.A., 2013. Information diffusion in online social networks: A survey. ACM Sigmod Record, 42(2), pp.17-28.
10. Karlova, N.A. and Fisher, K.E., 2013. A social diffusion model of misinformation and disinformation for understanding human information behaviour. IR Information Research (18)1, March 2013.
11. Fallis, D., 2015. What is disinformation?. Library Trends, 63(3), pp.401-426.
12. Godfrey-Smith, P., 1989. Misinformation. Canadian Journal of Philosophy, 19(4), pp.533-550.
13. Acevedo, C.G.F., 2020. From Cholera to COVID-19: A Historical Review of Misinformation during Pandemics. Progressio, 14.
14. Cohn Jr, S.K., 2007. The Black Death and the burning of Jews. Past and Present, 196(1), pp.3-36.
15. Law, A., 2017. Post-truth and fake news. Media Education Journal, 61, pp.3-6.
16. Pomerantsev, P., 2016. Why we're post-fact. Accessed from: https://granta. com/why-were-post-fact. [Accessed 2020-11-18]
17. Shannon, C.E. & Weaver, W. 1949. The mathematical theory of communication. University of Illinois Press.
18. Tuominen, K. and Savolainen, R., 1997. A social constructionist approach to the study of information use as discursive action. In Proceedings of an international conference on Information seeking in context (pp. 81-96).
19. Lévy, P. and Bononno, R., 1997. Collective intelligence: Mankind's emerging world in cyberspace. Perseus books.
20. Cukor, P. and McKnight, L., 2001. Knowledge networks, the Internet, and development. Fletcher F. World Aff., 25, p.43.
21. Lazer, D.M., Baum, M.A., Benkler, Y., Berinsky, A.J., Greenhill, K.M., Menczer, F., Metzger, M.J., Nyhan, B., Pennycook, G., Rothschild, D. and Schudson, M., 2018. The science of fake news. Science, 359(6380), pp.1094-1096.
22. Del Vicario, M., Bessi, A., Zollo, F., Petroni, F., Scala, A., Caldarelli, G., Stanley, H.E. and Quattrociocchi, W., 2016. The spreading of misinformation online. Proceedings of the National Academy of Sciences, 113(3), pp.554-559.
23. Keshavarz, H., 2014. How credible is information on the Web: Reflections on misinformation and disinformation. Infopreneurship Journal, 1(2), pp.1-17.
24. Guess, A., Nagler, J. and Tucker, J., 2019. Less than you think: Prevalence and predictors of fake news dissemination on Facebook. Science Advances, 5(1), p.eaau4586.
25. Cole, J., Watkins, C. and Kleine, D., 2016. Health advice from internet discussion forums: how bad is dangerous?. JIMR, 18(1), p.e4.

26. Cole, J. and Watkins, C., 2015. International employees' concerns during serious disease outbreaks and the potential impact on business continuity: Lessons identified from the 2014–15 West African Ebola outbreak. Journal of business continuity & emergency planning, 9(2), pp.149-162.
27. Wathen, C.N. and Burkell, J., 2002. Believe it or not: Factors influencing credibility on the Web. Journal of the American society for information science and technology, 53(2), pp.134-144.
28. COVID-19 Dashboard by the Center for Systems Science and Engineering at Johns Hopkins University. Available from:https://coronavirus.jhu.edu/map.html, [Accessed 2020-11-18]
29. Worldometers. [Accessed 2020-11-18] Available from: https://www.worldometers.info/coronavirus/
30. Institute of Health Metrics, COVID-19 Projections. [Accessed 2020-11-18] Available from: https://covid19.healthdata.org/global
31. Biggs, J.B., 1987. Student Approaches to Learning and Studying. Research Monograph. Australian Council for Educational Research Ltd., Radford House, Frederick St., Hawthorn 3122, Australia.
32. Fleming, N. D. (2001). Teaching and learning styles: VARK strategies. IGI Global.
33. Ichsan, Ilmi Zajuli, and Henita Rahmayanti. "HOTSEP: Revised Anderson's Taxonomy in Environmental Learning of COVID-19." European Journal of Educational Research 9, no. 3 (2020): 1257-1265.
34. Chaiuk, T.A. and Dunaievska, O.V., 2020. Fear Culture in Media: An Examination on Coronavirus Discourse. Journal of History Culture and Art Research, 9(2), pp.184-194.
35. Murphy, J., 2014. Eye on Ebola: FAQs for optometrists: don't participate in the panic, but do take reasonable and responsible precautions. Review of Optometry, 151(11), pp.4-7.
36. Carter, S.E., Gobat, N., Zambruni, J.P., Bedford, J., Van Kleef, E., Jombart, T., Mossoko, M., Nkakirande, D.B., Colorado, C.N. and Ahuka-Mundeke, S., 2020. What questions we should be asking about COVID-19 in humanitarian settings: perspectives from the Social Sciences Analysis Cell in the Democratic Republic of the Congo. BMJ Global Health, 5(9), p.e003607.
37. Cole J. 2017. The Role of Online Discussion Forums During a Public Health Emergency. (Doctoral Thesis, Royal Holloway, University of London.)
38. Evans, J.H. and Hargittai, E., 2020. Who Doesn't Trust Fauci? The Public's Belief in the Expertise and Shared Values of Scientists in the COVID-19 Pandemic. Socius, 6, p.2378023120947337.
39. Cairney,P. & Wellstead, A., 2020. COVID-19: Effective policymaking depends on trust in experts, politicians and the public. Pol Design & Practice, pp.1-14.
40. Allington, D., Duffy, B., Wessely, S., Dhavan, N. and Rubin, J., 2020. Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. Psych medicine, pp.1-7.
41. Burki, T., 2020. The online anti-vaccine movement in the age of COVID-19. The Lancet Digital Health, 2(10), pp.e504-e505.
42. Brzezinski, A., Kecht, V., Van Dijcke, D. and Wright, A.L., 2020. Belief in science influences physical distancing in response to covid-19 lockdown policies. University of Chicago, Becker Friedman Institute for Economics Working Paper, (2020-56).
43. Grimes, D.R., 2020. Health disinformation & social media: The crucial role of information hygiene in mitigating conspiracy theory and infodemics. EMBO reports, 21(11), p.e51819.
44. McPherson, K., 1994. The Cochrane Lecture. The best and the enemy of the good: randomised controlled trials, uncertainty, and assessing the role of patient choice in medical decision making. Journal of Epidemiology & Community Health, 48(1), pp.6-15.
45. Aitamurto, T. (2016, January). Collective Intelligence in Law Reforms: When the Logic of the Crowds and the Logic of Policymaking Collide. In System Sciences (HICSS), 2016 49th Hawaii International Conference on (pp. 2780-2789). IEEE.
46. Diviani, N., Putte, B., Giani, S., & Weert, J. C. M. (2015). Low health literacy and evaluation of online health information: a systematic review of the literature. Journal of Medical Internet Research, 17(5).
47. Whitelaw, N., Bhattacharya, S., McLernon, D., & Black, M. (2014). Internet information on birth options after caesarean compared to the RCOG patient information leaflet; a web survey. BMC pregnancy and childbirth, 14(1), 361
48. Dalkey, N. (1969). An experimental study of group opinion: the Delphi method. Futures, 1(5), 408-426.
49. Hlavacek, J., Maxwell, C. and Williams, J., 2009. Learn from new product failures. Research-Technology Management, 52(4), pp.31-39.

50. Sen, A., 1997. Maximization and the Act of Choice. Econometrica: Journal of the Econometric Society, pp.745-779.
51. Blocken, Bert, F. Malizia, T. van Druenen, and T. Marchal. Towards aerodynamically equivalent COVID19 1.5 m social distancing for walking and running. Questions and Answers. Available from: http://www. urbanphysics. net/COVID19. html [Accessed 2020-11-18]
52. Neiler, E. Are Running or Cycling Actually Risks for Spreading COVID19? Wired, 14 April 2020. Available from: https://www.wired.com/story/are-running-or-cycling-actually-risks-for-spreading-covid-19/ [Accessed 2020-11-13]
53. Callaway, E., 2020. The coronavirus is mutating-does it matter?. Nature, 585(7824), pp.174-177.
54. Hine, D., 2011. The 2009 Influenza Pandemic: An independent review of the UK response to the 2009 influenza pandemic. Cabinet Office.
55. Maxwell, D.N., Perl, T.M. and Cutrell, J.B., 2020. The Art of War in the Era of Coronavirus Disease 2019 (COVID-19). Clin infect diseases: official publication of the Infectious Diseases Society of America.
56. Funk, S., Gilad, E., Watkins, C. and Jansen, V.A., 2009. The spread of awareness and its impact on epidemic outbreaks. Proceedings of the National Academy of Sciences, 106(16), pp.6872-6877.
57. Williamson, P., 2016. Take the time and effort to correct misinformation. Nature 540(7632),pp.171-171.
58. Delingpole, J. 2017. Degingpole: How I Totally Crushed the Ocean Acidification Alarmist Loons. Breitbart, 9 Jan 2017. Available from: https://www.breitbart.com/europe/2017/01/09/delingpole-how-i-totally-crushed-the-ocean-acidification-alarmist-loons/ [Accessed 2020-13-2020].
59. Knight, V., 2020. US election: How covid-19 pushed doctors into the political arena like never before. bmj, 371.
60. Frumkin, H. and Myers, S.S., 2020. Planetary health and the 2020 US election. The Lancet, 396(10257), pp.1048-1050.
61. Science Media Centre. [Accessed 2020-11-13] Available from https://www.sciencemediacentre.org
62. Trevor Beford, Twitter Feed, Available from: https://twitter.com/trvrb?ref_src=twsrc%5Egoogle%7Ctwcamp%5Eserp%7Ctwgr%5Eauthor[Accessed 2020-11-18]
63. Dr John Campbell, YouTube Channel. Available from: https://www.youtube.com/channel/UCF9IOB2TExg3QIBupFtBDxg [Accessed 2020-11-18].
64. r/coronavirus. [Accessed 2020-11-18] Available from: https://www.reddit.com/r/Coronavirus/.
65. Collins, F. 2020. Genomic Study Points to Natural Origin of COVID19. 23 March 2020. Available from: https://directorsblog.nih.gov/2020/03/26/genomic-research-points-to-natural-origin-of-covid-19/ [Accessed 2020-11-18]
66. Andersen, K.G., Rambaut, A., Lipkin, W.I., Holmes, E.C. and Garry, R.F., 2020. The proximal origin of SARS-CoV-2. Nature medicine, 26(4), pp.450-452.
67. Pradhan, P., Pandey, A.K., Mishra, A., Gupta, P., Tripathi, P.K., Menon, M.B., Gomes, J., Vivekanandan, P. and Kundu, B., 2020. Uncanny similarity of unique inserts in the 2019-nCoV spike protein to HIV-1 gp120 and Gag. BioRxiv.
68. [Accessed 2020-11-18] Available from: https://www.reddit.com/r/China_Flu/comments/ewt9ep/scientific_paper_uncanny_similarity_of_unique/
69. [Accessed 2020-11-18] Available from: https://www.reddit.com/r/Coronavirus/comments/ewxne6/an_analysis_of_the_recent_paper_about_hiv/
70. Evanega, S., Lynas, M., Adams, J., Smolenyak, K. and Insights, C.G., 2020. Coronavirus misinformation: quantifying sources and themes in the COVID-19 'infodemic'. [Accessed 2020-11-18] Available from: https://allianceforscience.cornell.edu/wp-content/uploads/2020/10/Evanega-et-al-Coronavirus-misinformation-submitted_07_23_20.pdf
71. Zarocostas, J., 2020. How to fight an infodemic. The Lancet, 395(10225), p.676.
72. World Health Organization, 1st WHO Infodemic Management Training. [Accessed 2020-11-12] Available from: https://www.who.int/teams/risk-communication/infodemic-management/1st-who-training-in-infodemic-management.
73. Scientific American Editors (2020). Scientific American endorses Joe Biden: We've never backed a presidential candidate in our 175-year history—until now. Scientific American October 2020. Available from: https://www.scientificamerican.com/article/scientific-american-endorses-joe-biden1/ [Accessed 2020-11-12].