



Science, society, and policy in the face of uncertainty: reflections on the debate around face coverings for the public during COVID-19

Graham P. Martin , Esmée Hanna , Margaret McCartney & Robert Dingwall

To cite this article: Graham P. Martin , Esmée Hanna , Margaret McCartney & Robert Dingwall (2020): Science, society, and policy in the face of uncertainty: reflections on the debate around face coverings for the public during COVID-19, Critical Public Health, DOI: [10.1080/09581596.2020.1797997](https://doi.org/10.1080/09581596.2020.1797997)

To link to this article: <https://doi.org/10.1080/09581596.2020.1797997>



© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 10 Aug 2020.



Submit your article to this journal [↗](#)



Article views: 1103



View related articles [↗](#)



View Crossmark data [↗](#)

Science, society, and policy in the face of uncertainty: reflections on the debate around face coverings for the public during COVID-19

Graham P. Martin^a, Esmée Hanna^b, Margaret McCartney^c and Robert Dingwall^d

^aThe Healthcare Improvement Studies Institute, University of Cambridge, Cambridge, UK; ^bSchool of Allied Health Sciences, De Montfort University, Leicester, UK; ^cGeneral Practitioner, Glasgow, UK; ^dDingwall Enterprises Ltd and School of Social Sciences, Nottingham Trent University, Nottingham, UK

ABSTRACT

The COVID-19 pandemic has had enormous effects on health, wellbeing, and economies worldwide. Governments have responded with rapid and sometimes radical public health interventions. As nations grapple with the question of how to regain normality without unnecessarily endangering lives or healthcare systems, some scientists have argued for policies to encourage or compel the use of face coverings in community (non-clinical) settings, despite acknowledged gaps in the evidence base for the effectiveness of such a measure. This commentary has two objectives. First, in the face of strong arguments that face coverings are a commonsense intervention, with negligible downsides, that can only do good, we make the case for caution in changing policy. Many seemingly benign public health interventions have the potential to cause harm, and that harm is often socially differentiated. We present five arguments for caution in policy change. Second, we reflect on the wider implications of the increasingly overt approaches to policy advocacy taken by some scientists. Drawing from the theory of post-normal science, we argue that the science–policy interface in the case of face coverings has taken a surprisingly traditional form, falling short of interdisciplinary integration and failing to incorporate insights of the full range of relevant experts and affected stakeholders. We sketch a vision for an alternative, more mature, relationship between science and society that accepts uncertainty, embraces deliberation, and rises to the challenge of developing knowledge to improve public health.

ARTICLE HISTORY

Received 21 May 2020
Accepted 15 July 2020

KEYWORDS

Facemasks; face masks; science policy; evidence-based policy; post-normal science

Introduction

With its huge consequences for individuals, societies and economies, the coronavirus pandemic has accelerated interactions between science and public policy as the world strives to reduce harm and restore normal life. Since the prospect of a vaccine, or effective treatment, for COVID-19 is uncertain, questions of how best to minimise its impact are currently central to the science–policy interface. Scientists are asked to inform complex policy decisions at pace, and often on the basis of partial knowledge and inconclusive evidence bases. Changes in policy, including laws, regulations and government guidance, have followed with equal speed, in some countries facilitated by exceptional constitutional measures to permit change with reduced levels of democratic scrutiny. This rapid process of knowledge production and translation has given rise to evolving and sometimes

inconsistent recommendations from public health authorities, and divergent responses across countries and jurisdictions.

One key area of contestation and rapid policy development is the question of whether viral transmission, outside health and social care settings, can be reduced if citizens wear face masks or coverings. Conventional epidemiological knowledge provides limited support for this notion, with multiple systematic and rapid reviews (largely in preprint form at the time of writing) concluding, for example, that ‘the evidence is not sufficiently strong to support widespread use of facemasks as a protective measure against COVID-19’ (Brainard et al., 2020), that ‘masks alone have no significant effect in interrupting spread of [influenza-like illnesses]’ (Jefferson et al., 2020), and that ‘the scientific evidence should be considered equivocal’ (Perski et al., 2020). Yet several prominent biomedical scientists and public health academics have publicly advocated policies to encourage, or even enforce, use of face coverings, despite the limitations of the evidence base (Cheng et al., 2020; Gandhi et al., 2020; Greenhalgh & Howard, 2020; Greenhalgh et al., 2020; Javid et al., 2020). Many countries have compelled, or strongly recommended, mask-wearing in public (Feng et al., 2020). The World Health Organization’s (WHO) guidance has moved from discouragement (in April 2020) to encouragement (in June) (World Health Organization, 2020a, 2020b). The governments of the four nations of the United Kingdom have recommended or required face coverings in certain settings, for example, on public transport, subject to certain exceptions (Cabinet Office, 2020).

In this commentary we have two objectives. First, we set out the case *against* policies that, despite the equivocal evidence base, encourage or (particularly) mandate routine wearing of face coverings in public, as advocated in an open letter signed by some hundred or more public health scientists worldwide (<https://masks4all.co/letter-over-100-prominent-health-experts-call-for-cloth-mask-requirements/>), and adopted in some countries. Well-intended population health interventions can do harm, but the downsides of mandatory face-covering policies have to date been under-conceptualised and under-studied (Bakhit et al., 2020). We suggest that it is crucial to consider the unintended consequences and potential harms of such a shift, through a structured, scientific approach, especially when faced with strong arguments from authoritative and eminent individuals. Second, we reflect on the wider implications of the increasingly overt approaches to policy advocacy taken by some scientists. We note the consequences of a compressed science-policy interface that prioritises simplicity of messaging over acknowledgement of uncertainty (Sarkki et al., 2014), and highlight how it neglects the interests of some groups altogether. Moreover, we argue that it results in a relationship between science and policy that is surprisingly conservative, didactic and linear – at a time when dialogue between science, policy and society is more important than ever (Funtowicz & Ravetz, 1993; Gibbons et al., 1994). In concluding, we imagine how the desire for clear direction from science in a time of crisis might instead be harnessed to forge a more mature relationship between science, policy and the public, with benefits not only for trust, but for the generation and application of sound and useful evidence.

Mass uptake of face coverings in community settings: the case for caution

Others have made a detailed case for a policy that encourages or compels the wearing of face coverings in non-clinical public settings, so we summarise it only briefly. Advocates of policies to encourage or compel face coverings point to their plausibility as an intervention (including evidence of efficacy at a mechanical level, in reducing propulsion of contaminated droplets from the wearer’s mouth and nose, including presymptomatic individuals) (Cheng et al., 2020; Gandhi et al., 2020; Howard et al., 2020), observational evidence in countries that have had success in limiting coronavirus transmission (Cheng et al., 2020; Greenhalgh et al., 2020), and the relatively limited harms likely to arise from a low-cost, low-tech intervention (Greenhalgh et al., 2020; Javid et al., 2020).

The case against a change in policy on face coverings, however, has not been made systematically. This argument is premised largely on what we *do not* know. It is founded upon the absence of evidence, rather than on evidence of absence of effect or existence of harm. Nevertheless, these

unknowns are important. The case against a shift in policy towards the expectation or requirement of face covering might be made at five levels.

First, there is very limited evidence that cloth face coverings reduce the burden of respiratory illnesses such as COVID-19 (Brainard et al., 2020; Jefferson et al., 2020; Perski et al., 2020; Xiao et al., 2020). Although some important studies followed the outbreak caused by SARS-CoV-1 in the early 2000s, the quality and clarity of the subsequent evidence base for face coverings as a means of reducing community transmission is disappointing. Few studies examine the use of face coverings in community settings: when taken in aggregate, those that do find no statistically significant evidence of reduced transmission compared with no face coverings (Jefferson et al., 2020). Observational studies of face covering are, as one might expect, heavily confounded by the parallel implementation of other measures such as physical distancing and isolation, and experimental studies are limited by the impossibility of blinding and thus weak adherence in intervention and control groups (Brainard et al., 2020). Of course, absence of evidence is not evidence of absence, and some analyses are more promising than others. One study that found no evidence of effect on an intention-to-treat basis, for example, found a statistically significant association on the basis of self-reported behaviour (MacIntyre et al., 2009). Literature reviews cautiously suggest that in some circumstances, wearing of face coverings may be warranted, for example, in 'community settings where contact may be casual and relatively brief' (Brainard et al., 2020), in 'specific settings where the risk of infection is high and the opportunity for physical distancing is low' (Perski et al., 2020), and in clinical settings (Jefferson et al., 2020). But existing research also provides little information on potential harms, such as 'discomfort, dehydration, facial dermatitis, distress, headaches, exhaustion' (Jefferson et al., 2020). Here, equally, absence of evidence should not be taken as evidence of absence (Bakhit et al., 2020).

Second, it is unclear how the general public would use face coverings, or how readily good practice might be disseminated and taken up. Proper use of face coverings is not straightforward. Even healthcare workers can find it difficult (Nichol et al., 2013); poor use (including poor fitting, adjustment, touching) of face masks can reduce effectiveness and pose an infection risk in itself. Used disposable face masks must be removed and discarded properly because they accumulate pathogens (World Health Organization, 2020a); inappropriately discarded masks present an infection risk. For non-disposable cloth-based coverings, the evidence base is slim, although MacIntyre et al.'s (2015) hospital-based three-arm trial found worse infection outcomes in wearers of cloth masks than in wearers of medical masks and in a control group (usual practice, which included much mask-wearing). Cloth coverings retain moisture, with indeterminate consequences for their efficacy and for the creation of a microbiological environment favourable to other bacterial or viral organisms. One public-facing summary of the evidence advocates homemade coverings fashioned from a 't-shirt, handkerchief, or paper towel, or [...] a scarf or bandana,' ideally using 'tightly woven fabric' and 'including a layer of paper towel as a disposable filter' (Greenhalgh & Howard, 2020). The World Health Organization (2020b), in contrast, states that cloth coverings should consist of at least three layers. The availability of resources, including time, space and materials to prepare, don, doff and properly disinfect a homemade covering will vary markedly by socio-economic and other demographic characteristics.

Third, at the microsocial level, the argument might be made that encouraging uptake of face coverings would lead to reduced compliance with other measures, by creating a false sense of security. This argument rests on evidence around risk compensation in other areas of public health. The evidence here is inconsistent, with some studies finding evidence of increased risk to self or others, and others finding no effect (e.g., Esmailikia et al., 2019; Hagel & Meeuwisse, 2004; Hedlund, 2000). There is also a counter-argument: that uptake of one measure might support uptake of other, complementary, measures (Cheng et al., 2020). Nevertheless, face coverings might promote, if not active risk-taking, then at least a degree of complacency that reduces adherence to other measures. Perski et al.'s (2020) review, for example, note that those allocated to the face mask arm in one trial reported reduced use of hand sanitiser, though four other studies found no difference in hand hygiene across trial arms. Any complacency that does arise might be mitigated by the more selective

use of face coverings in higher-risk environments rather than universal advice or compulsion (Brainard et al., 2020; Perski et al., 2020), which might do more to maintain their additive role and emphasise the importance of proper use in riskier contexts. Face coverings also bring complications for communication for those who are deaf, hard-of-hearing or visually impaired, who rely variously on lip-reading and/or unmuffled speech for communication (Grote & Izagaren, 2020), as well as for people with cognitive disabilities: a reduction in physical distancing here would have little to do with risk compensation. There is also an argument that universal face-covering might aggravate the climate of fear already documented for COVID-19 (Asmundson & Taylor, 2020), adding to mental health concerns by providing a constant reminder of the threat posed by other humans.

Fourth, potential downsides of policy to encourage or mandate face coverings in community settings present themselves at the macrosocial level. Advocates acknowledge that wider uptake of masks might result in greater pressure on supply chains for healthcare workers, but argue that the proper response is to produce more masks (Greenhalgh et al., 2020; Javid et al., 2020). Given the likely sustained demand for masks, however, and in light of the global difficulty in procuring appropriate personal protective equipment for healthcare workers (Horton, 2020; Perencevich et al., 2020), the ease with which such a call can be answered is questionable. Some advocates suggest that homemade coverings might offer an interim alternative (Cheng et al., 2020; Greenhalgh et al., 2020). If they prove ineffective, or are associated with negative outcomes, however, a rush to obtain equipment intended for use by healthcare workers is conceivable. The likely consequences for healthcare staff in such a scenario are stark. The social dynamics of widespread face-covering are also difficult to anticipate but potentially adverse, particularly where coverings are mandated or enforced. As a highly visible symbol of virtuous behaviour, those who fail to comply may be subject to stigmatisation or worse. Even a permissive policy risks 'gold-plating' (Voermans, 2009), where over-compliance by particular institutions, like public transport operators, effectively imposes a universal rule. Indeed just such a process was evident in Sin's (2016) study of mask-wearing in China following the outbreak of the first SARS coronavirus, while in the UK, incremental moves towards requiring face-covering in specific settings (such as public transport) have been followed by increasing calls for mandatory universal face-covering from high-profile bodies including the British Medical Association (2020). Meanwhile, notwithstanding the weak evidence base for face coverings as a standalone measure, businesses or states might see widespread or mandatory face-covering as a warrant for a premature return to 'business as usual', justifying unsafe workplaces or crowded commuting conditions – particularly for those in 'blue-collar' occupations, not afforded the privilege of working at home (Kantamneni, 2020). Advice on face-covering in England, for example, recommends wearing a covering in 'enclosed public spaces where social distancing isn't possible,' even while acknowledging that 'face coverings do not replace social distancing' (Cabinet Office, 2020). While for long-term population health a return to economic activity is vital, the means by which this is achieved could result in socially stratified risks and benefits (Ahmed et al., 2020).

This leads to our final point. The consequences of a public health intervention of this nature – particularly, though not exclusively, if legally mandated – are by their nature difficult to anticipate. Face coverings (and measures to secure their uptake) are complex interventions in a complex system: the results of a change of this nature are emergent, unpredictable, and potentially counterintuitive (Braithwaite et al., 2018). In complex systems, the outcomes of intervention are never fully amenable to either prediction or evaluation, but it is nevertheless crucial to give due consideration to the harms that might accrue (Bonell et al., 2015), investigate them scientifically, and adapt accordingly (Reed et al., 2018). Given the bluntness of national and international policy imposition as a mechanism of change, revisions may prove very challenging once decisions (particularly to mandate) are made.

Evidence and policy in unusual times

The existence of uncertainties over the effectiveness of a public health intervention, and the possibility of unintended consequences differentially distributed across a population, are of course not unique to face coverings, though the urgency with which authorities are asked to act is more

acute than with most issues. The case for caution in encouraging or mandating face coverings outlined above encompasses a breadth of issues, from questions of their efficacy at a mechanical level, through uncertainties about their effectiveness in populations at an epidemiological level, to much wider social and ethical questions about the distribution of benefits and drawbacks across society. As an issue that cuts across disciplinary boundaries and involves axiological as well as scientific questions, the issue of face-coverings exemplifies what Funtowicz and Ravetz (1993, p. 744) have termed 'post-normal science', 'where facts are uncertain, values in dispute, stakes high and decisions urgent,' and so a response that transcends disciplinary boundaries and engages politically is required. They offer the concept of post-normal science as both a description and a normative prescription for multidisciplinary scientific fields with vital societal consequences, such as climate science and the new genetics. Like parallel accounts of the contemporary relationship between science and society, such as 'Mode 2' knowledge production (Gibbons et al., 1994), it calls for science that is interdisciplinary, politically engaged, and subject to review, critique and engagement not just from scientists but from an 'extended peer community' (Funtowicz & Ravetz, 1993). Such communities include both those affected most acutely by scientific decisions, and individuals who hold diverse forms of expertise, with or without formal credentials (Collins & Evans, 2002).

In some ways, the increasing stridence of scientific advocates of face coverings might be seen as embracing post-normal science. In the absence of a clear answer from epidemiology, they compile insights from other fields – for example, microbiology or bioethics (Greenhalgh et al., 2020; Howard et al., 2020). But in converting these insights into a policy-oriented case for change, subtlety is sacrificed for certainty. A notable feature of many such calls is a claim that the case for action is clear and unequivocal, or even that scientific consensus about the balance of risks and benefits has been reached. One lay summary, for example, by the authors of a commentary and a literature review (Greenhalgh et al., 2020; Howard et al., 2020) declares boldly that 'the science says yes' (Greenhalgh & Howard, 2020). Unlike the reviews cited earlier (Brainard et al., 2020; Jefferson et al., 2020; Perski et al., 2020; Xiao et al., 2020), the authors of the literature review underpinning this message reach a strongly pro-coverings conclusion. They draw on an eclectic range of disciplines. Their methods, however, are opaque: the review's two-sentence description of methods states that 'a community-driven approach was used for building the paper list used' (Howard et al., 2020), an approach with clear potential for bias, at least from the perspective of the epidemiological tradition of systematic review.

Rather than integrating multidisciplinary insights to provide a synergistic *interdisciplinary* understanding of the kind imagined by post-normal science, then, the case for face coverings is based on a questionable compilation of *monodisciplinary* insights. But more than this, as claims that the science behind face coverings is unequivocal are turned into policy mandates at pace, so the opportunity for deliberation among the extended peer community is lost. This includes both those with relevant expertise, with or without formal credentials (Collins & Evans, 2002), and those most affected by policy change (Funtowicz & Ravetz, 1993) – for example, those asked to cover their faces in lieu of other measures to contain the virus in the course of working or commuting, or those whom face coverings may significantly disadvantage, such as people who are deaf. Assertions about scientific consensus circumvent debate within the scientific community and with others inside and outside academia with relevant expertise; rapid imposition of laws or regulations precludes mechanisms of democratic control that would usually be expected before such major policy interventions, such as parliamentary debates or impact assessments.

Politicians crave visible interventions that show they are taking action (Strong, 1990); uncertainty is easily glossed over as evidence makes the leap from academia to the world of policy. Public health cannot wait for unequivocal evidence, and decisions must be made on imperfect knowledge, and informed by values as well as evidence. However, the speed with which an open scientific question is converted into an unequivocal scientific message and thence a blunt policy intervention with important potential unintended consequences means that – ironically – the opportunity for enacting post-normal science is squandered in just the kind of situation where it seems most warranted.

'Simple messages' are prioritised over 'communicating uncertainty'; responsiveness is prioritised over 'time-consuming quality assessment' and 'consensus building processes between plural perspectives' (Sarkki et al., 2014, pp. 199–200). The debate becomes polarised and binary: if the science says yes to face coverings, then challenging the orthodoxy or even questioning its universality becomes heretical. The potential harms from unconditional advocacy that fails to engage the extended peer community and the wider public, moreover, go beyond the downsides of the implementation of one policy. They include the erosion of trust in science as a field in general, when the measures put forward fail to live up to their promise, or result in problems that could be, or had been, anticipated.

We argue instead that there is opportunity for public engagement with science, not just in deliberating how to act in the face of an uncertain evidence base, but also in improving that evidence base. Research during a public health emergency is not a luxury but should be an integral part of society's response. In the case of face coverings, it might include quasi-experimental comparative studies of geographically differentiated approaches to supplying and supporting uptake, observational studies of use of use and hygiene behaviours, and various forms of qualitative research to anticipate and record mechanisms and identify unintended consequences. Rather than communicate a falsely unequivocal message about the value of face coverings, researchers should articulate scientific disagreement, the nature of scientific uncertainty, and its implications for how we act to improve knowledge and action. Acceding to calls to impose policy change on the basis of uncertain knowledge means sacrificing an outstanding opportunity to improve the evidence base. During the 2014 Ebola outbreak, no randomised controlled trial of drug treatments was completed and no new therapies were identified (Kalil, 2020). The result was avoidable uncertainty for the future. The impact of COVID-19 and the desire for solutions is universal: there is an opportunity to engage the public in research endeavours that could not only have huge public-health benefits, but could also change the relationship between science and society for the better.

Conclusion

The COVID-19 pandemic is moving quickly. Research moves more slowly; academic publishing slower still. By the time this piece is published, debate may have moved on from face coverings, whether because of an improved evidence base, policy decisions more or less informed by evidence, or even significant progress towards vanquishing the virus. Our arguments, however, go beyond the specifics of face coverings or SARS-CoV-2. They relate above all to the reciprocal responsibilities of science, policy and society in an environment of uncertainty and urgency. Sometimes uncertainty and urgency necessitate a rapid and radical response. But whenever there is space – even limited – to review relevant evidence, anticipate unintended consequences, engage those with relevant expertise and those most affected in meaningful deliberation, and instigate work to increase our knowledge in order to reduce disease and harms, policymakers and scientists alike must seize it.

Acknowledgements

We thank Jane O'Hara and Anne Campbell for helpful comments on earlier drafts of this manuscript, two anonymous peer reviewers for their helpful critique, and many people who have engaged with and helped us to improve our arguments via social media. Responsibility for errors or omissions is the authors' alone.

Disclosure statement

A full list of Margaret McCartney's interests is available at <http://www.whopaysthisdoctor.org/doctor/6/active>. Robert Dingwall is a member of the UK government's New and Emerging Respiratory Viral Threats Advisory Group (NERVTAG),

Moral and Ethical Advisory Group (MEAG), and an occasional adviser to the Cabinet Office. He writes here in a personal capacity. No potential conflict of interest was reported by the other authors.

Funding

Graham Martin is supported by the Health Foundation's grant to the University of Cambridge for The Healthcare Improvement Studies Institute. The Healthcare Improvement Studies Institute is supported by the Health Foundation – an independent charity committed to bringing about better health and healthcare for people in the United Kingdom.

References

- Ahmed, F., Ahmed, N., Pissarides, C., & Stiglitz, J. (2020). Why inequality could spread COVID-19. *The Lancet Public Health*, 5(5), e240. [https://doi.org/10.1016/S2468-2667\(20\)30085-2](https://doi.org/10.1016/S2468-2667(20)30085-2)
- Asmundson, G. J. G., & Taylor, S. (2020). Coronaphobia: Fear and the 2019-nCoV outbreak. *Journal of Anxiety Disorders*, 70, 102196. <https://doi.org/10.1016/j.janxdis.2020.102196>
- Bakhit, M., Krzyzaniak, N., Scott, A. M., Clark, J., Glasziou, P., & Mar, C. D. (2020). Downsides of face masks and possible mitigation strategies: A systematic review and meta-analysis. <https://doi.org/10.1101/2020.06.16.20133207>
- Bonell, C., Jamal, F., Melendez-Torres, G. J., & Cummins, S. (2015). 'Dark logic': Theorising the harmful consequences of public health interventions. *Journal of Epidemiology and Community Health*, 69(1), 95–98. <https://doi.org/10.1136/jech-2014-204671>
- Brainard, J. S., Jones, N., Lake, I., Hooper, L., & Hunter, P. (2020). Facemasks and similar barriers to prevent respiratory illness such as COVID-19: A rapid systematic review. <https://doi.org/10.1101/2020.04.01.20049528>
- Braithwaite, J., Churrua, K., Long, J. C., Ellis, L. A., & Herkes, J. (2018). When complexity science meets implementation science: A theoretical and empirical analysis of systems change. *BMC Medicine*, 16(1), 63. <https://doi.org/10.1186/s12916-018-1057-z>
- British Medical Association. (2020). *BMA calls for face coverings to be worn by public 'as a matter of course'*. BMA. Retrieved June 29, 2020, from <https://www.bma.org.uk/news-and-opinion/bma-calls-for-face-coverings-to-be-worn-by-public-as-a-matter-of-course>
- Cabinet Office. (2020). *Guidance: Staying safe outside your home*. Retrieved June 29, 2020, from <https://www.gov.uk/government/publications/staying-safe-outside-your-home/staying-safe-outside-your-home>
- Cheng, K. K., Lam, T. H., & Leung, C. C. (2020). Wearing face masks in the community during the COVID-19 pandemic: Altruism and solidarity. *The Lancet*. in press. [https://doi.org/10.1016/S0140-6736\(20\)30918-1](https://doi.org/10.1016/S0140-6736(20)30918-1)
- Collins, H. M., & Evans, R. (2002). The third wave of science studies: Studies of expertise and experience. *Social Studies of Science*, 32(2), 235–296. <https://doi.org/10.1177/0306312702032002003>
- Esmailikia, M., Radun, I., Grzebieta, R., & Olivier, J. (2019). Bicycle helmets and risky behaviour: A systematic review. *Transportation Research Part F: Traffic Psychology and Behaviour*, 60, 299–310. <https://doi.org/10.1016/j.trf.2018.10.026>
- Feng, S., Shen, C., Xia, N., Song, W., Fan, M., & Cowling, B. J. (2020). Rational use of face masks in the COVID-19 pandemic. *The Lancet Respiratory Medicine*, 8(5), 434–436. [https://doi.org/10.1016/S2213-2600\(20\)30134-X](https://doi.org/10.1016/S2213-2600(20)30134-X)
- Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures*, 25(7), 739–755. [https://doi.org/10.1016/0016-3287\(93\)90022-L](https://doi.org/10.1016/0016-3287(93)90022-L)
- Gandhi, M., Yokoe, D. S., & Havlir, D. V. (2020). Asymptomatic transmission, the Achilles' heel of current strategies to control Covid-19. *New England Journal of Medicine*, 382(22), 2158–2160. <https://doi.org/10.1056/NEJMe2009758>
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge*. Sage.
- Greenhalgh, T., & Howard, J. (2020). *Masks for all? The science says yes*. fast.ai. Retrieved April 19, 2020, from <https://www.fast.ai/2020/04/13/masks-summary/>
- Greenhalgh, T., Schmid, M. B., Czypionka, T., Bassler, D., & Gruer, L. (2020). Face masks for the public during the covid-19 crisis. *BMJ*, 369, m1435. <https://doi.org/10.1136/bmj.m1435>
- Grote, H., & Izagaren, F. (2020). Covid-19: The communication needs of D/deaf healthcare workers and patients are being forgotten. *BMJ*, 369, m2372. <https://doi.org/10.1136/bmj.m2372>
- Hagel, B., & Meeuwisse, W. (2004). Risk compensation: A "side effect" of sport injury prevention? *Clinical Journal of Sport Medicine*, 14(4), 193–196. <https://doi.org/10.1097/00042752-200407000-00001>
- Hedlund, J. (2000). Risky business: Safety regulations, risk compensation, and individual behavior. *Injury Prevention*, 6(2), 82–89. <https://doi.org/10.1136/ip.6.2.82>
- Horton, R. (2020). Offline: COVID-19 and the NHS—'a national scandal'. *The Lancet*, 395(10229), 1022. [https://doi.org/10.1016/S0140-6736\(20\)30727-3](https://doi.org/10.1016/S0140-6736(20)30727-3)
- Howard, J., Huang, A., Li, Z., Tufekci, Z., Zdimas, V., Westhuizen, H.-M. van der, Delft, A. von, Price, A., Fridman, L., Tang, L.-H., Tang, V., Watson, G. L., Bax, C. E., Shaikh, R., Questier, F., Hernandez, D., Chu, L. F., Ramirez, C. M., & Rimoin, A. W.

- (2020). *Face masks against COVID-19: An evidence review*. Retrieved April 19, 2020, from <https://www.preprints.org/manuscript/202004.0203/v1>
- Javid, B., Weekes, M. P., & Matheson, N. J. (2020). Covid-19: Should the public wear face masks? *BMJ*, *369*, m1442. <https://doi.org/10.1136/bmj.m1442>
- Jefferson, T., Jones, M., Ansari, L. A. A., Bawazeer, G., Beller, E., Clark, J., Conly, J., Mar, C. D., Dooley, E., Ferroni, E., Glasziou, P., Hoffman, T., Thorning, S., & Driel, M. V.. (2020). Physical interventions to interrupt or reduce the spread of respiratory viruses. Part 1 - Face masks, eye protection and person distancing: Systematic review and meta-analysis. <https://doi.org/10.1101/2020.03.30.20047217>
- Kalil, A. C. (2020). Treating COVID-19—off-label drug use, compassionate use, and randomized clinical trials during pandemics. *JAMA*, *323*(19), 1897–1898. <https://doi.org/10.1001/jama.2020.4742>
- Kantamneni, N. (2020). The impact of the COVID-19 pandemic on marginalized populations in the United States: A research agenda. *Journal of Vocational Behavior*, *119*, 103439. <https://doi.org/10.1016/j.jvb.2020.103439>
- MacIntyre, C. R., Cauchemez, S., Dwyer, D. E., Seale, H., Cheung, P., Browne, G., Fasher, M., Wood, J., Gao, Z., Booy, R., & Ferguson, N. (2009). Face mask use and control of respiratory virus transmission in households. *Emerging Infectious Diseases*, *15*(2), 233–241. <https://doi.org/10.3201/eid1502.081166>
- MacIntyre, C. R., Seale, H., Dung, T. C., Hien, N. T., Nga, P. T., Chughtai, A. A., Rahman, B., Dwyer, D. E., & Wang, Q. (2015). A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. *BMJ Open*, *5*(4), e006577. <https://doi.org/10.1136/bmjopen-2014-006577>
- Nichol, K., McGeer, A., Bigelow, P., O'Brien-Pallas, L., Scott, J., & Holness, D. L. (2013). Behind the mask: Determinants of nurse's adherence to facial protective equipment. *American Journal of Infection Control*, *41*(1), 8–13. <https://doi.org/10.1016/j.ajic.2011.12.018>
- Perencevich, E. N., Diekema, D. J., & Edmond, M. B. (2020). Moving personal protective equipment into the community: Face shields and containment of COVID-19. *JAMA*, *323*(22), 2252–2253. <https://doi.org/10.1001/jama.2020.7477>
- Perski, O., Simons, D., West, R., & Michie, S. (2020). Face masks to prevent community transmission of viral respiratory infections: A rapid evidence review using Bayesian analysis. *Qeios*. <https://doi.org/10.32388/15C5L4>
- Reed, J. E., Howe, C., Doyle, C., & Bell, D. (2018). Simple rules for evidence translation in complex systems: A qualitative study. *BMC Medicine*, *16*(1), 92. <https://doi.org/10.1186/s12916-018-1076-9>
- Sarkki, S., Niemelä, J., Tinch, R., van den Hove, S., Watt, A., & Young, J. (2014). Balancing credibility, relevance and legitimacy: A critical assessment of trade-offs in science–policy interfaces. *Science & Public Policy*, *41*(2), 194–206. <https://doi.org/10.1093/scipol/sct046>
- Sin, M. S. Y. (2016). Masking fears: SARS and the politics of public health in China. *Critical Public Health*, *26*(1), 88–98. <https://doi.org/10.1080/09581596.2014.923815>
- Strong, P. (1990). Epidemic psychology: A model. *Sociology of Health & Illness*, *12*(3), 249–259. <https://doi.org/10.1111/1467-9566.ep11347150>
- Voermans, W. J. M. (2009). Gold-plating and double banking: An overrated problem? In H. J. Snijders & S. Vogenauer (Eds.), *Content and meaning of national law in the context of transnational law* (pp. 79–88). Sellier European Law Publishers.
- World Health Organization. (2020a, April 6). *Advice on the use of masks in the context of COVID-19: Interim guidance*. WHO.
- World Health Organization. (2020b, June 5). *Advice on the use of masks in the context of COVID-19: Interim guidance*. WHO.
- Xiao, J., Shiu, E. Y. C., Gao, H., Wong, J. Y., Fong, M. W., Ryu, S., & Cowling, B. J. (2020). Nonpharmaceutical measures for pandemic influenza in nonhealthcare settings—personal protective and environmental measures. *Emerging Infectious Diseases*, *26*(5), 967–975. <https://doi.org/10.3201/eid2605.190994>