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## Analysis

### How Covid-19 spreads: narratives, counter-narratives and social dramas

Trisha Greenhalgh<sup>1</sup>  
Mustafa Ozbilgin<sup>2</sup>  
David Tomlinson<sup>3</sup>

<sup>1</sup> Nuffield Department of Primary Care Health Sciences, University of Oxford

<sup>2</sup> Brunel University London, Uxbridge, UB8 3PH, UK

<sup>3</sup> University Hospitals Plymouth NHS Trust

#### Correspondence to:

Professor Trisha Greenhalgh  
Nuffield Department of Primary Care Health Sciences, University of Oxford  
Woodstock Rd  
Oxford OX2 6GG  
UK  
Email: [trish.greenhalgh@phc.ox.ac.uk](mailto:trish.greenhalgh@phc.ox.ac.uk)  
Phone: 01865 289363

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#### KEY MESSAGES

- **A flawed ‘Covid is droplet-but-not-airborne-transmitted’ narrative became entrenched early in the pandemic**
- **Measures aimed at an assumed droplet pathogen (handwashing, surface cleansing, physical distancing) were over-emphasised**
- **Measures to reduce airborne transmission (improving indoor air quality, reducing indoor crowding and time spent indoors, and high-grade respiratory protection) were under-emphasised.**
- **UK policymakers appeared to favour ‘inside track’ narratives from a narrow group of scientific advisers**
- **Consequences included care home deaths, mission-critical delays in public masking, and avoidable infections of frontline workers**

31 **Key words**

32 COVID-19, SARS-CoV-2, pandemic, airborne transmission, facemasks, face coverings,  
33 health policy

34

35 **Contributors and sources**

36 The interdisciplinary author team was from secondary care medicine (DT), primary care and  
37 public health (TG), and critical social science (MO). All authors drafted sections of the  
38 manuscript. TG produced an initial synthesis which was then improved by iteration and  
39 discussion. All authors approved the final manuscript

40

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44 Stephen Reicher for helpful comments on an earlier draft and suggestions of additional  
45 references on psychological theories.

46

47

48 **Patient involvement**

49 The article relates to a public health issue which affects everyone. As such, we are all  
50 potential patients. TG lost her mother to hospital-acquired Covid-19 so brings a user  
51 perspective on nosocomial transmission.

52

53

54 **Conflicts of Interest**

55 We have read and understood [BMJ policy on declaration of interests](#) and have the following  
56 interests to declare:

57

58 MO declares no conflicts of interest. In November 2020, DT contacted Public Health  
59 England, the Chair of NERVTAG, the Department of Health and Social Care and NHS  
60 England to request improved personal protective equipment for healthcare staff. In February  
61 2021, TG added her signature to a letter from the Royal College of Nursing to the UK Prime  
62 Minister making a similar request.

63

64

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76

77

78 How Covid-19 spreads: narratives, counter-narratives and social dramas

79

80 *Trisha Greenhalgh and colleagues explore why inaccurate narratives about the mode of*  
81 *transmission of SARS-CoV-2 emerged early in the pandemic and shaped a flawed policy*  
82 *response, with tragic consequences.*

83

84 **Introduction**

85 The draft terms of reference for the UK COVID-19 Inquiry embrace not just *what* decisions  
86 were made but also *how* and *why* they were made.<sup>1</sup> As Dyani Lewis argued recently in  
87 *Nature*, the World Health Organisation overlooked--and at times explicitly denied--airborne  
88 transmission of SARS-CoV-2 for over two years despite early evidence suggesting that this  
89 was an important and perhaps the dominant route of transmission.<sup>2</sup> UK policymakers  
90 likewise adhered to an assumed droplet mode of transmission and prioritised interventions  
91 accordingly, neglecting the key topic of indoor air quality.<sup>3</sup>

92

93 This paper, which focuses mainly on the UK, considers how flawed narratives about the  
94 nature of SARS-CoV-2 transmission arose and became entrenched, leading to misplaced  
95 policies and avoidable deaths. We invite the Inquiry to consider not just those specific  
96 flawed decisions but also what we believe is a culture of premature scientific conclusions  
97 and reluctance to engage with uncertainty.

98

99 **Policymaking as a struggle between narratives**

100 Policymaking is a contact sport involving competing narratives (about problems, how they  
101 arose, and how they will be resolved), institutions (especially government and its  
102 bureaucratic machinery) and interests (financial, political, ideological).<sup>4</sup> Policy may (ideally)  
103 “follow science” but a key question is *whose* science and why? Science shapes policy  
104 narratives via an “inside track” (e.g. official advisory committees) and to a lesser extent by an  
105 “outside track” (e.g. less mainstream scientists, citizen movements).<sup>4</sup> Pandemic  
106 policymaking has been characterised not by clearly-identified knowledge gaps which science  
107 obligingly fills but by toxic clashes between competing scientific and moral narratives.

108

109 Getting the mode of transmission right matters, because preventive strategies follow (Table  
110 1).<sup>5,6</sup> Being honest about scientific uncertainty also matters, because—among other  
111 reasons—it is hard to back-track after declaring a policy “evidence-based”.<sup>7</sup>

112

113 **Table 1: Droplet versus airborne transmission: implications for public health and**  
114 **healthcare worker protection**

Droplet transmission	Airborne transmission
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<p>If an infectious pathogen spreads predominantly through large respiratory droplets that fall quickly, the most important public health measures are:</p> <ul style="list-style-type: none"> <li>- respiratory hygiene (e.g. sneezing into tissues)</li> <li>- disinfecting surfaces and objects (fomites) onto which droplets may have fallen</li> <li>- reducing direct contact (e.g. do not shake hands with others or touch one's own face)</li> <li>- staying physically apart from others at a distance that reflects the effect of gravity on droplets (1-2 metres)</li> <li>- wearing facemasks within that droplet distance</li> <li>- physical barriers (such as visors of plastic screens)</li> <li>- providing respirator-grade facial protection for healthcare staff who undertake so-called "aerosol-generating" procedures</li> </ul> <p>These contact, droplet and fomite precautions do not distinguish between indoor and outdoor settings, since a gravity-driven mechanism for transmission would operate similarly in both.</p>	<p>If an infectious pathogen is mainly airborne, a person could potentially be infected when they inhale aerosols emitted in the breath of an infected person. These aerosols may remain suspended in the air for many hours. Reducing airborne transmission requires measures to avoid inhalation of infectious aerosols, including</p> <ul style="list-style-type: none"> <li>- engineering controls in indoor spaces (ventilation, air filtration)</li> <li>- reducing crowding (e.g. by encouraging people to work from home if possible)</li> <li>- reducing time spent indoors (e.g. frequent breaks for school classes)</li> <li>- maximising physical distance between people indoors (even beyond 2 metres)</li> <li>- wearing masks whenever indoors</li> <li>- careful attention to mask quality (to maximise filtration) and fit (to avoid air getting in via gaps)</li> <li>- taking particular care in indoor activities that generate aerosols (e.g. speaking, singing, exercising)</li> <li>- providing respirator-grade facial protection for health-care staff and other front-line workers</li> </ul>
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115 In this paper, we first contrast inside-track narratives of SARS-CoV-2 transmission from the  
116 World Health Organisation, UK government and their official scientific advisers with outside-  
117 track counter-narratives offered by aerosol scientists. We then examine the tragic human  
118 consequences of these preferred narratives, which we present as social dramas.<sup>8</sup>

119

120 **Competing narratives around transmission**

121 *"Covid is droplet-, not airborne-, spread"*

122 At a press conference on 11<sup>th</sup> February 2020, the World Health Organisation's Director-  
123 General announced that "corona[virus-19] is airborne".<sup>9</sup> After a prompt, he corrected himself  
124 and declared that the virus was transmitted by droplets (coughs, sneezes and contaminated  
125 objects). The reasons for this hasty correction are not fully known, but may have included a  
126 desire to prevent public panic (the World Health Organisation has long considered airborne  
127 diseases to be potential bioterrorist threats, requiring respirator-grade personal protective  
128 equipment<sup>10</sup>), avoid exacerbating a major supply-chain issue with such equipment in the  
129 face of known international shortages,<sup>11</sup> and take account of the very limited availability of  
130 high-grade personal protective equipment in low-resource settings.

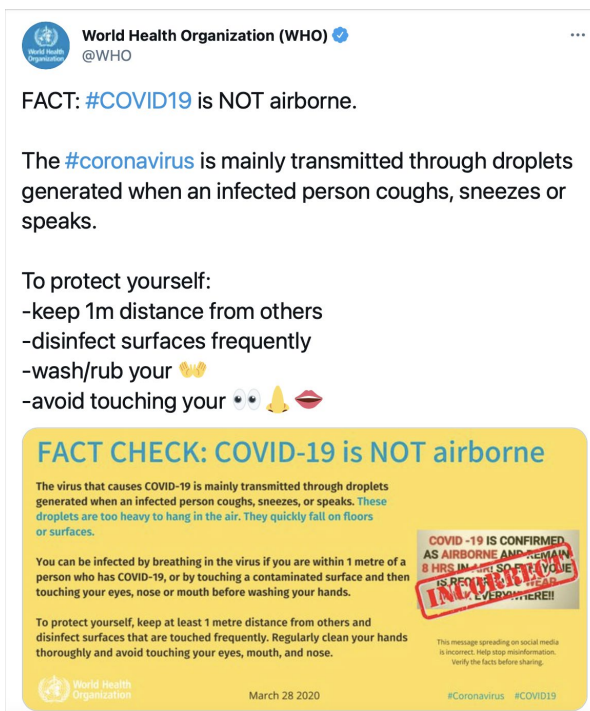
131

132 The World Health Organisation's early public information campaign promoted droplet  
133 measures—handwashing, respiratory hygiene and disinfection of surfaces and objects  
134 (Table 1, column a)—and firmly reassured the public that the virus was not airborne (Figure  
135 1). This stance reflected the dominance of infection prevention and control clinicians—whose  
136 day jobs included enforcing controls against droplet-borne infections in hospitals—on key  
137 committees.<sup>12</sup> Airborne precautions for airborne diseases are, of course, a legitimate

138 component of infection prevention and control science, but in practice this professional group  
 139 has focused historically on droplet precautions.<sup>13</sup>

140

141 **Figure 1: Tweet from World Health Organisation on 28<sup>th</sup> March 2020 denying airborne**  
 142 **transmission of SARS-CoV-2**



143

144 The UK government’s narrative (Table 2, column 1) mirrored the World Health  
 145 Organisation’s. It did not reflect nuanced discussions in the Scientific Advisory Group on  
 146 Emergencies (SAGE), some of whose members had raised the possibility of other  
 147 transmission routes on 18<sup>th</sup> February 2020.<sup>14</sup> Rather, it reflected advice from a small group of  
 148 infection prevention and control experts (known as the “IPC Cell”) from Public Health  
 149 England, Public Health Wales, NHS Scotland and Public Health Agency Northern Ireland  
 150 (see Appendix on bmj.com) who favoured a droplet-but-not-airborne narrative.

151

152 **Table 2: Contrasting early announcements about preventing transmission of SARS-**  
 153 **CoV-2 from England and Japan**

From Public Health England	From the Japanese Prime Minister’s office
<p><i>“There are general principles you can follow to help prevent the spread of respiratory viruses, including:</i></p> <ul style="list-style-type: none"> <li>- <i>washing your hands more often - with soap and water for at least 20 seconds or use a hand sanitiser when you get home or into work, when you blow your nose, sneeze or cough, eat or handle food</i></li> <li>- <i>avoid touching your eyes, nose, and mouth with unwashed hands</i></li> <li>- <i>avoid close contact with people who have symptoms</i></li> </ul>	<p><i>“The locations where mass infections were confirmed so far are places where the following three conditions were met simultaneously: (1) closed space with poor ventilation, (2) crowded with many people and (3) conversations and vocalization in close proximity (within arm’s reach of one another). It is believed that more people were infected in such places. Therefore, we ask that you predict locations and settings where these three conditions could occur simultaneously and avoid them. We do not have enough scientific evidence yet on how significantly such actions can</i></p>

<ul style="list-style-type: none"> <li>- cover your cough or sneeze with a tissue, then throw the tissue in a bin and wash your hands</li> <li>- clean and disinfect frequently touched objects and surfaces in the home”</li> </ul> <p>(posted 3<sup>rd</sup> March 2020, updated 30<sup>th</sup> March 2020, withdrawn 1<sup>st</sup> May 2020<sup>15</sup>)</p> <p>This narrative assumes a droplet mode of transmission and implies a high level of certainty.</p>	<p>reduce the risk of spreading infection. However, since places with poor ventilation and crowded places are increasing infections, we ask that you take precautions even before scientific evidence for clear standards is found.” (page 2)</p> <p>(posted 9<sup>th</sup> March 2020<sup>16</sup>)</p> <p>This narrative assumes the <i>possibility</i> of airborne transmission and asks citizens to share the uncertainty and act in a precautionary way.</p>
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The droplet-but-not-airborne narrative emphasised randomised controlled trials (see appendix on bmj.com);<sup>17</sup> it drew implicitly on the *hierarchy of evidence*—a formalisation of the assumed superiority of randomised trials, which “... typically serve[s] the needs and realities of clinical medicine, but not necessarily public policy” (page 665).<sup>18</sup> It did not acknowledge the *hierarchy of controls*—a public health framework incorporating system-level interventions to eliminate pathogens, environmental controls aimed at making air and water safe, and behavioural interventions.<sup>19</sup> This mindset appears to have led policymakers to reject a wealth of wider evidence on the science of how to optimise indoor air quality.<sup>6</sup>

“Covid is unequivocally airborne”

Aerosol scientists study how fluids and particles travel in the air. Some had specialised in how respiratory pathogens—including tuberculosis, influenza and other coronaviruses such as SARS and MERS—travel. They had shown, using laboratory studies, real-world case studies and computer modelling, that these pathogens are transmitted by aerosols and require airborne mitigation measures (Table 1, column 2), and that coughs and sneezes generate turbulent gas clouds of different-sized particles which can travel long distances.<sup>20</sup>

From early 2020, evidence accumulated from a range of study designs to support the hypothesis that, like most other respiratory pathogens—and perhaps more so than other coronaviruses—SARS-CoV-2 is transmitted through the air (Box 1).<sup>5 21-23</sup>

<p><b>Box 1: 10 streams of evidence in support of airborne transmission of SARS-CoV-2</b> <i>Adapted from Greenhalgh et al<sup>22</sup></i></p> <ol style="list-style-type: none"> <li>1. Superspreading events: the virus is often transmitted at mass events from one or a few people to many people.<sup>24 25</sup></li> <li>2. Long-range transmission: the virus spreads in shared air among people who have never physically met or touched any common surface.<sup>26</sup></li> <li>3. Asymptomatic and presymptomatic transmission: a high proportion of people who pass on the virus have no symptoms at the time.<sup>27</sup></li> <li>4. Indoor dominance: transmission is many times greater indoors than outdoors, and ventilation reduces transmission.<sup>28</sup></li> <li>5. Nosocomial infections occur despite strict contact-and-droplet precautions, and reduce when airborne precautions are added.<sup>29</sup></li> </ol>
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6. Whilst SARS-CoV-2 is difficult to isolate from air, viable SARS-CoV-2 was detected early in the pandemic in real-world settings where infected people had been.<sup>30-32</sup>
7. SARS-CoV-2 has been detected in air filters in building ducts (could only have got there via airborne route).<sup>33</sup>
8. Transmission between animals has occurred when their cages were connected via air ducts.<sup>34</sup>
9. The virus exhibits overdispersion (one person with Covid-19 may infect no-one; another may infect dozens).<sup>35</sup>
10. Empirical evidence supporting droplet or fomite transmission is sparse.<sup>36 37</sup>

175

176 Countries such as Japan,<sup>16</sup> where inside-track aerosol scientists had the ear of  
177 government,<sup>12</sup> had introduced airborne precautions early in the pandemic (Table 2 column  
178 2). But in most Western countries, the aerosol narrative initially fell on deaf policy ears. By  
179 July 2020, aerosol scientists were alarmed that official advice was based on over-simplistic  
180 and incorrect models of transmission (which had perpetuated for decades in the infection  
181 control literature<sup>38</sup>), and wrote an open letter to the World Health Organisation offering to  
182 help.<sup>5</sup>

183

184 *“Covid is ‘situationally’ airborne”*

185 From the outset, the World Health Organisation’s guidance on protecting healthcare workers  
186 from Covid-19 recommended a standard level of protection for most activities but a higher  
187 level for so-called “aerosol-generating” ones,<sup>39</sup> reflecting on a long-established (but flawed)  
188 medical research tradition. Its Infection Prevention and Control Research and Development  
189 Expert Group for COVID-19 (IPCRDEG-C19) did not initially include any aerosol scientists  
190 and appeared to ignore the open offer of help. A new scientific brief was quickly published,  
191 reiterating the dominance of droplet transmission in most circumstances but acknowledging  
192 airborne transmission in certain situations—*aerosol-generating medical procedures and*  
193 *crowded, poorly-ventilated indoor settings.*<sup>40</sup>

194

195 Whilst some parts of the World Health Organisation subsequently welcomed the input of  
196 aerosol scientists, and changed the guidance in December 2021 to recommend higher-  
197 grade personal protective equipment (including N95 respirators) for all COVID-19 patient  
198 care,<sup>41</sup> the Expert Group dominated by infection prevention and control experts dissented  
199 from this overall view, as noted in the following footnote (page 1): *“\*\*\* WHO provides this*  
200 *interim recommendation independent of the COVID-19 infection prevention and control*  
201 *Guidelines Development Group.”*

202

203 That group continued to promote the “situationally airborne” narrative, which has persisted  
204 despite evidence against it (next section), and has far-reaching implications. If aerosols

205 transmit only when certain procedures are being performed, only a small fraction of  
206 healthcare staff need higher-grade protection, and only when performing particular  
207 procedures. If that assumption is incorrect, staff (especially non-medical and less senior  
208 ones) and patients in most healthcare facilities are under-protected.

209

210 *“Everyone generates aerosols; everyone is vulnerable”*

211 A systematic review revealed wide disagreement among guideline panels about which  
212 procedures and activities should count as “aerosol generating” (and hence earn respirator-  
213 grade protection for the person doing them).<sup>42</sup> Many procedures (e.g. taking a  
214 nasopharyngeal swab) were inconsistently classified; some aerosol-generating acts (e.g.  
215 coughing) were not procedures; and several procedures were classified as aerosol-  
216 generating only because they induced coughing.<sup>42</sup> A review of the physiology and  
217 aerodynamics of respiratory acts concluded that coughing, sneezing, breathing (especially if  
218 laboured), speaking and singing generated significant amounts of aerosol; well-documented  
219 super-spreader events for Covid-19 involved a critical triad of poor ventilation, crowding and  
220 loud vocalisation.<sup>43</sup>

221

222 These findings raise some paradigm-challenging questions. Should respirator-grade  
223 protection be worn by everyone—including other patients—*whenever patients are coughing?*  
224 Should more attention be paid to measures higher up the hierarchy of controls, such as  
225 ventilation or filtration of air, or ensuring that fewer people share air and for shorter periods?  
226 In the sections which follow, we consider some dramatic consequences of the UK  
227 government’s decision (reflecting influential voices in the World Health Organisation) to  
228 deny, dismiss or downplay the importance of airborne transmission of SARS-CoV-2.

229

### 230 **Social dramas**

231 *Droplet precautions became ritualised*

232 The official droplet-but-not-airborne narrative materialised as artefacts (e.g. posters,  
233 disinfectant dispensers, 2-metre distancing markers) and social practices (actions accepted  
234 and expected in particular contexts). Droplet-directed practices became ubiquitous among  
235 individuals, who washed hands and forearms assiduously for 20 seconds, quarantined and  
236 disinfected their post, and stayed a measured distance apart, and also in institutions, who  
237 installed and policed the various artefacts and practices.

238

239 These rituals of purification<sup>44</sup> powerfully reinforced the official narrative. “Clean” and  
240 “contaminated” came to be demarcated in terms of how recently and thoroughly hands had



241 been sanitised and how far a droplet was assumed to travel (Table 1, column 1). The same  
242 rituals served to downplay or obscure the narrative of aerosol transmission—which  
243 demarcated “clean” and “contaminated” in terms of air purity, with practices oriented to  
244 controlling indoor crowding and time spent indoors, ventilating or filtering air, and optimising  
245 quality and fit of masks (Table 1, column 2). These material and enacted features of policy  
246 discourse served to further silence the “Covid-is-airborne” narrative.

247

#### 248 *Care home residents died in their thousands*

249 On 23<sup>rd</sup> March 2020, with up to 500,000 deaths and an overwhelmed National Health  
250 Service predicted, the UK Prime Minister announced a national lockdown (“stay at home”,  
251 “protect the NHS”). Hospitals had switched into urgent discharge mode from 19<sup>th</sup> March,  
252 sending patients back to care homes without routine pre-discharge testing. Between March  
253 and June 2020, 18,104 deaths involving Covid-19 and 11,169 additional deaths above the 5-  
254 year UK average occurred in care home residents.<sup>45</sup>

255

256 Amnesty International depicted the UK’s care home crisis as a gross breach of human rights  
257 in which thousands of vulnerable people had been treated as expendable.<sup>46</sup> The crisis was  
258 also largely avoidable. Public Health England’s guidance for care homes had emphasised a  
259 situationally-airborne narrative.<sup>47</sup> Since aerosol-generating procedures were rarely  
260 undertaken in care homes, these settings were de facto low priority for personal protective  
261 equipment. Under-emphasis of the importance of ventilation and no routine use of masks are  
262 likely to have greatly amplified transmission between infectious residents and care home  
263 staff. In Hong Kong, by contrast, surgical masks were mandated for all care home staff by  
264 late January 2020 and no excess care home deaths occurred in wave 1.<sup>48</sup>

265

#### 266 *Public masking became a libertarian lightning rod*

267 Libertarianism is a political ideology which favours individual choice, freedom and a retreat  
268 from state and institutional control. Libertarians resist imposed rules and like to do their own  
269 research rather than trust scientists or government. Uncertainty and conflict about the value  
270 and place of public masking allowed libertarian messages and practices to flourish.

271

272 At its 4<sup>th</sup> February 2020 meeting, the Scientific Advisory Group on Emergencies advised  
273 masks for symptomatic Covid-19 patients to reduce transmission “if tolerated”.<sup>14</sup> This group  
274 had acknowledged the potential for asymptomatic transmission of SARS-CoV-2 on 28<sup>th</sup>  
275 January 2020,<sup>14</sup> but did not make the logical leap to recommend masking asymptomatic  
276 people as source control. Indeed, in official meetings between January and April 2020, either  
277 public masking was not mentioned or arguments against it—lack of efficacy, harm, wastage—

278 were tabled (see Appendix on bmj.com).<sup>14</sup> Public announcements and professional videos<sup>49</sup>  
279 issued by Public Health England between February and June 2020 presented masking as  
280 ineffective and potentially harmful, on the grounds that people might take compensatory  
281 risks or self-contaminate when they put on or removed their mask (the “donning” and  
282 “doffing” of infection control jargon). They provided no evidence to support these claims.

283

284 The confusion about masking in key decision-making committees was due partly to  
285 confusion about mode of transmission. Whereas asymptomatic transmission of the virus  
286 reflects a predominantly airborne route (since asymptomatic people are by definition not  
287 coughing or sneezing), the preoccupation with self-contamination and donning and doffing  
288 rituals reflected a predominantly droplet mode (Table 1). Wearing a cloth or surgical mask  
289 protects others (imperfectly) from transmission by droplets and (to some extent) aerosols;  
290 wearing a well-fitting respirator-grade mask also provides strong protection for the wearer  
291 against aerosol transmission.<sup>50</sup> A mental model of droplet transmission explains the limited  
292 attention paid to the *type* of mask and also the excessive concern about self-contamination.

293

294 The contested efficacy of facemasks in controlling SARS-CoV-2 transmission can be  
295 explained in terms of how much of the evidence base one is prepared to consider.<sup>50</sup> An  
296 influential inside-track narrative appeared to conflate absence of relevant randomised  
297 controlled trial evidence with evidence that masking was ineffective.<sup>17</sup> Outside-track  
298 scientists argued for the precautionary principle, on the grounds that there was—as early as  
299 March 2020—indirect and mechanistic evidence (notably, around asymptomatic  
300 transmission) and strong theoretical arguments for public masking, and huge potential risks  
301 associated with delay.<sup>51</sup>

302

303 Mask mandates were finally introduced in England on 15<sup>th</sup> June 2020 (public transport) and  
304 24<sup>th</sup> July 2020 (all public places). By then, public opinion was polarised and many believed it  
305 was an ineffective measure.<sup>52</sup> Most Asian countries had high public compliance with early  
306 masking policies and very low death rates; many Western countries introduced masking late  
307 and had many more deaths, though causal links are complex and confounders many.<sup>53</sup>

308

309 Masking policies in USA, and to a lesser extent UK, met with a strong libertarian backlash  
310 aligned with populist political leaders, right-wing Christianity, anti-authoritarian social media  
311 groups and—latterly—anti-vaccination groups.<sup>54</sup> In this context, masks came to symbolise  
312 pointless restriction of individual freedom, mindless compliance with authoritarian  
313 governments, and even blasphemy.<sup>55</sup>

314

315 *Healthcare settings became occupational health battlegrounds*

316 As documented in the 9<sup>th</sup> January minutes of the New and Emerging Respiratory Virus  
317 Threats Advisory Group (NERVTAG), SARS-CoV-2 was initially classified as a High  
318 Consequence Infectious Disease (HCID) by the Four Nations Public Health Agencies.<sup>56</sup>  
319 Consequently, staff caring for suspected or confirmed Covid-19 patients required filtering  
320 facepiece [FFP3] respirators or equivalent. This reflected guidance from the UK Health  
321 Security Agency (previously Public Health England) and Health and Safety Executive on  
322 other coronaviruses and avian influenza, and legal requirements for employers to protect  
323 their workers against airborne biohazards. The Health and Safety Executive had concluded  
324 in 2008 that surgical masks “*should not be used in situations where close exposure to*  
325 *infectious aerosols is likely*”.<sup>57</sup>

326  
327 However, NERVTAG minutes from 13<sup>th</sup> March 2020 reflect growing concern about shortages  
328 of respirator masks and the Department of Health and Social Care’s request for “adapted”  
329 guidance that recommended surgical masks in most circumstances.<sup>56</sup> The Deputy Chief  
330 Medical Officer agreed to meet with the Chair of the Advisory Committee on Dangerous  
331 Pathogens, whose members: “were unanimous in supporting the declassification of COVID-  
332 19 as a HCID” (13<sup>th</sup> March 2020, paragraph 2.11).<sup>56</sup>

333  
334 The declassification of COVID-19 in early March 2020 had profound implications for the  
335 protection of frontline healthcare workers. The following sentence, for example, was present  
336 in version 8.1 of Health Protection Scotland’s guidance for clinicians on infectious pathogens  
337 (dated 5<sup>th</sup> March 2020).

338  
339 *“The precautionary principle should be applied for all novel or emerging respiratory*  
340 *pathogens of high consequence when the mode of transmission is incompletely*  
341 *determined. Airborne precautions (including the use of correctly fitted FFP3*  
342 *respirators) should be applied for all patients admitted with suspected or confirmed*  
343 *COVID-19.”* (page 3)<sup>58</sup>

344  
345 But this entire paragraph had been *removed* from version 9.0 of the guidance (dated 10<sup>th</sup>  
346 March 2020).<sup>59</sup> Notes in a marked-up version 8.1 obtained by us under the Freedom of  
347 Information Act reveal a comment against the paragraph as follows: “subject to change  
348 based on NERVTAG PPE decisions”.

349  
350 Whilst NERVTAG minutes from 6<sup>th</sup> March 2020 allude to severe shortages of respirator-  
351 grade protective equipment, this was not made explicit in communications to either

352 healthcare organisations or the public. A letter to UK healthcare organisations dated 28<sup>th</sup>  
353 March 2020, sent jointly from NHS England and NHS Improvement, Public Health England  
354 and the Academy of Medical Royal Colleges, stated that because of rising Covid-19 cases  
355 and because “more was understood about the behaviour of the virus and its clinical  
356 outcomes” (i.e. in view of the assumed droplet-but-not-airborne narrative),<sup>60</sup> respirator-grade  
357 protection would now be restricted to aerosol-generating procedures.<sup>60</sup>

358

359 The number of UK health and care workers infected with SARS-CoV-2 at work is not  
360 officially documented. The Secretary of State for Health and Social Care reported that by  
361 mid 2021, around 1500 had died of Covid-19 and 120,000 had developed long covid (some  
362 of whom remained on long-term sick leave).<sup>61</sup> In April 2020, excess deaths were noted  
363 amongst healthcare staff (especially men and minority ethnic groups) working outside  
364 intensive care units, and this impression was confirmed in subsequent academic  
365 publications.<sup>62</sup> In early 2021, the British Medical Association and Royal College of Nursing  
366 demanded respirator-grade protection for all staff working with Covid-19 patients.

367

368 The latest guidance from the UK Health Security Agency continues to promote a  
369 situationally-airborne narrative and restrict respirator use to aerosol-generating procedures.<sup>63</sup>  
370 It does not recommend respirator masks for all Covid-19 patient care, on the grounds that  
371 transmission is not “wholly” via the airborne route. However, the document glossary states,  
372 “Airborne particles can be released when a person coughs or sneezes, and during AGPs  
373 [aerosol generating procedures]”. There remains wide variation in infection control policies in  
374 different NHS trusts (perhaps because some interpret the guidance as mandatory); those  
375 which provide respirator-grade protection appear to have significantly lower nosocomial  
376 infection rates for Covid-19.<sup>64</sup>

377

## 378 **Discussion**

379 At the root of the UK’s limited success in controlling transmission of SARS-CoV-2 lay flawed  
380 droplet-but-not-airborne and situationally-airborne narratives. These narratives, and the false  
381 certainty with which they were conveyed, produced ineffective public health measures,  
382 contributed to shocking levels of care home deaths, exacerbated toxic discourse on  
383 masking, and justified withholding adequate protection from most health and care staff.

384

385 Why did the flawed narratives prevail? We consider four complementary hypotheses.

386

387 The first is psychological. Social representation theory holds that individuals faced with new  
388 information exhibit two tendencies: anchoring (grounding the new in an existing framework of

389 concepts, ideas and values) and concretisation (in which something abstract is made  
390 meaningful by making it physical and tangible).<sup>65</sup> Individuals are unlikely to change their  
391 beliefs in light of complex and contravening evidence, because this requires effort and  
392 presents an aversive state for most people.<sup>66</sup> Policymakers are known to exhibit *satisficing*—  
393 that is, narrowing the parameters within which their decisions must make sense and be  
394 accountable, especially when threats are complex and urgent.<sup>67</sup> These well-documented  
395 psychological tendencies in individuals may underpin the tendency for business and policy  
396 decisions to show what has been termed “escalation of commitment to a failing course of  
397 action”.<sup>7</sup>

398

399 Our second hypothesis is scientific elitism. Scientists in infection control have amassed  
400 considerable scientific capital (i.e. influence, status, accolades); their favoured methods  
401 (randomised controlled trials) are greatly valued; and they have much to lose if they discard  
402 their long-held droplet narrative and concede the importance of other kinds of evidence.<sup>12</sup>  
403 The inside track for pandemic policymaking in the UK and World Health Organisation was  
404 narrow and partisan,<sup>12 68</sup> enabling an unusual degree of power to be wielded against outside-  
405 track scientific voices, imposing a narrow and rigid set of acceptable scientific methods (what  
406 Danziger called “methodolatry”<sup>69</sup>), and precluding the kind of interdisciplinary deliberation  
407 that might have allowed a full and fair consideration of important competing narratives.

408

409 The low status of aerosol science in policy circles was perhaps compounded by the relatively  
410 youth of this scientific field and the inherent technical difficulties of isolating viable virus from  
411 the air (resulting in inconsistent findings in air sampling studies, especially when undertaken  
412 by non-experts).<sup>21</sup> The science of indoor air quality (e.g. how and when to open windows,  
413 what kinds of filters to use) may be (wrongly) viewed as unsophisticated compared with  
414 much of modern biomedicine.<sup>3</sup>

415

416 Our third hypothesis is practical and logistical. As confirmed in official minutes, the national  
417 shortage of high-grade respiratory protective equipment was a live discussion topic in UK  
418 policy advisory groups at the beginning of the pandemic (see examples above). Whilst  
419 adherence to a droplet-but-not-airborne narrative was not consciously undertaken purely  
420 *because of* this shortage, it certainly helped to make existing stocks go further.

421

422 Our fourth hypothesis is political. Droplet precautions are, at least to some extent, under the  
423 control of individuals and hence resonate with neoliberal discourses about individual  
424 freedom, personal responsibility and restraint of the state (though the “choice” to physically  
425 distance, for example, presupposes sufficient space in which to do so). Airborne precautions

426 require a 'paradigm shift' in policy making, with strategic actions from those responsible for  
427 public safety; this approach aligns with a more socialist-leaning political discourse and  
428 requires considerable up-front investment in the built environment whose benefits may take  
429 years to accrue.<sup>6</sup> The World Health Organisation's tweet (Figure 1) emphasises how to  
430 protect *yourself* rather than what to expect of your employer, your child's school or your  
431 government. Relatedly, we hypothesise a role for populism, whose modus operandi is  
432 cherry-picking evidence that supports the policy drive and valorises anti-science sentiment  
433 under the guise of bringing power to people.<sup>70</sup> Populism drew on public desires to return to  
434 normalcy and further marginalised aerosol science by depicting its recommended measures<sup>6</sup>  
435 as obscure, unaffordable and an enemy of the public interest.

436

437 The narratives and dramas presented in this paper are not exhaustive. The framing of  
438 protection as a matter of individual responsibility, for example, also accommodates the  
439 current political narrative of "learning to live with Covid-19", in which good citizens stoically  
440 accept the endemicity of a—hopefully attenuating—virus in exchange for greater individual  
441 freedoms.

442

443 The Covid-19 pandemic can be framed as what Marcel Mauss (cited in Chaunlat<sup>71</sup>) calls a  
444 "total social fact", a phenomenon which affects all domains and layers of society (economic,  
445 legal, political, religious) and requires us to draw evidence from across multiple scientific and  
446 other sub-fields. In such circumstances, the combination of policymakers' cognitive biases  
447 and satisficing behaviour, scientists' desire to protect their interests, and politicians'  
448 alignment with individualist values and populist sentiment proved perilous.

449

450 As the pandemic continues to cause high levels of death and long-term illness 30 months  
451 after the first case, airborne transmission of SARS-CoV-2 and the mitigations needed to  
452 address it (column 2 in Table 1) remain misunderstood and under-recognised.

453 Extraordinarily, a recent UK inquiry into errors made in the pandemic did not mention masks  
454 or ventilation at all.<sup>72</sup> Whilst we acknowledge that solutions are always much more evident in  
455 retrospect, we believe the Inquiry should ask hard questions about policymakers'  
456 accountability in relation to past and ongoing omissions in this regard. Box 2 suggests ten  
457 specific questions for the Inquiry.

458

#### **Box 2: Questions for the Inquiry**

459

1. Given the very different implications of an airborne mode of transmission for effective control of the pandemic (column 3 of Table 1), why were early indications that this virus could be airborne overlooked by policymakers, resulting in public health measures that over-emphasised handwashing, surface cleansing and 2-metre distancing? What checks and balances might have helped policymakers keep a more open mind about mode of

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- 464 transmission rather than seeing it as a settled issue from an early stage?  
465 2. Why did policymakers convey an unjustified level of scientific certainty about the mode of  
466 transmission and measures to prevent transmission (column 1 of Table 2), rather than—as  
467 other countries did (e.g. Japan, column 2 of Table 2)—sharing with the public that the mode  
468 was not yet known? How might the culture of UK policy bodies change to foster greater  
469 intellectual engagement with scientific uncertainty and how to handle it?  
470 3. What was (and is) the membership and terms of reference of the UK’s “Infection Prevention  
471 and Control (IPC) Cell”? Who appoints them? Who checks their work? Does this group  
472 include any experts on airborne transmission and the delivery of safe indoor air? Why did  
473 (and does) this group have such a high degree of influence on policy? Why are its activities  
474 (at least partly) hidden from the public? Where are the minutes of its meetings?  
475 4. Why did policymakers continue to de-emphasise the evidence base on the airborne mode of  
476 transmission for so long, even as strong and consistent empirical evidence was  
477 accumulating? To what extent were cognitive biases, such as escalating commitment to a  
478 failing course of action,<sup>7</sup> operating at either individual or group level? How might such  
479 biases have been minimised or overcome?  
480 5. Why did policymakers continue to place so much emphasis on droplet precautions even  
481 after they had accepted that the virus was likely airborne? Why was indoor air quality given  
482 so little attention not just at the beginning of the pandemic but two years (and counting)  
483 into it?  
484 6. To what extent were policy decisions—for example to downgrade Covid-19 from a high-  
485 consequence infectious disease and to provide either inadequate or no respiratory  
486 protection equipment (RPE) for health and care workers—adversely influenced (either  
487 consciously or unconsciously) by the shortage of high-grade RPE? Who made these  
488 decisions and what is the chain of accountability?  
489 7. To what extent was the limited public confidence in the efficacy of masks influenced by  
490 negative policy announcements on this subject early in the pandemic? Why were early  
491 statements that masks were likely ineffective and could be harmful not corrected as  
492 evidence to refute them accumulated? What lessons might specific public health leaders be  
493 encouraged to learn from this error?  
494 8. Why are UK health and care workers still not fully protected against airborne infections in  
495 the workplace? Why is a premature and false narrative that the pandemic is over being used  
496 to justify not supplying frontline workers with RPE designed to protect against airborne  
497 pathogens?  
498 9. Given that the evidence for airborne transmission of SARS-CoV-2 is strong, are experts in  
499 aerosol science now adequately represented on all key science advisory bodies and are  
500 measures in place to ensure that their advice is sought and heeded?  
501 10. Why have policymakers located prime responsibility for preventive measures with  
502 individuals (e.g. handwashing, mask-wearing to protect the self), given that many effective  
503 preventive measures for airborne transmission are located at institutional and national  
504 policy levels (e.g. air quality and crowding standards in buildings, occupational health and  
505 safety, mask mandates to protect others)?

506

507 Bold action is now needed to ensure that the science of SARS-CoV-2 transmission is freed  
508 from the shackles of historical errors, scientific vested interests, ideological manipulation and  
509 policy satisficing. Policymakers should actively seek to broaden the scientific inside track to  
510 support interdisciplinarity and pluralism as a route to better policies, greater accountability  
511 and a reduction in the huge inequities that the pandemic has generated.

512

513

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