



1 **Viewpoint**

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3 **How Amplification of Denial Spread COVID Misinformation and**  
4 **Undermined the Credibility of Public Health Science**

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13 **Running Title:** Contrarian Amplification Spread COVID Misinformation

14 **Abstract**

15 Denialist scientists have played an outsized role in shaping public opinion and determining  
16 public health policy during the recent COVID pandemic. From early on, amplification of  
17 researchers who denied the threat of COVID and/or the benefits of intervention (denialists)  
18 shaped public opinion and undermined public health policy. The forces that amplify  
19 denialists include 1) Motivated Amplifiers seeking to protect their own interests by  
20 supporting denialist scientists, 2) Conventional Media outlets giving disproportionate time to  
21 denialist opinions, 3) Promoters of controversy seeking to gain traction in an ‘attention  
22 economy,’ and 4) Social Media creating information silos in which denialists can become the  
23 dominant voice. Contrarian amplification poses an existential threat to science relevant to  
24 public policy. It is incumbent on the scientific community to create a forum to accurately  
25 capture the collective perspective of the scientific community related to public health policy  
26 that is open to dissenting voices but prevents artificial amplification of denial.

27

28 **Keywords:** COVID, amplification of denial, misinformation, science communication,  
29 social media

30

31 **Key Messages:**

- 32 1. The disproportionate amplification of denial distorted public perception of science  
33 and undermined public health policy during the COVID pandemic.  
34 2. Contrarian amplification can result either from intentional support of denialists by  
35 those threatened by the prevailing scientific perspective or by virtue of the attention



36 economy that drives conventional media, social media, and, to some extent,  
37 scientific publishing.  
38 3. Countering amplification of denial requires creating an open forum for the scientific  
39 community that captures the collective views of subject matter experts without  
40 amplification of denial.  
41



42 **Introduction**

43 Denialist scientists have played an outsized role in shaping public opinion and determining  
44 public health policy during the COVID pandemic (January 2020-May 2023 per WHO) and  
45 continued to reshape the narrative with regard to public health interventions in its aftermath.  
46 Denialism represents something far different from the rigorous, informed critique of research,  
47 including one's own, which is the skepticism essential to science. Contrarians not only reject  
48 the majority view of the scientific evidence, but they replace it with their own entirely  
49 different interpretation, often with minimal self-skepticism. Industries or institutions which  
50 are threatened by the implications of the majority belief, from tobacco to fossil fuels, have  
51 long sought to support and amplify denialist scientists [1,2]. The number of scientists with  
52 little or no subject matter expertise or experience, who staked out denialist positions, seemed  
53 to explode during the pandemic. Conventional media often provides a platform for denialists  
54 in the name of balance. The urgent pace of pandemic science coupled with the unique ability  
55 of social media to promote controversy took amplification of denial to an unprecedented  
56 level. The resulting deterioration of public confidence in public health science poses an  
57 existential threat to rational public health policy. How did this happen?

58 To understand the nature and effect of amplification of denial and what we might do to  
59 limit its impact, consider two publications as case studies. One, from early in the pandemic,  
60 concluded that COVID was far less deadly than the public health community believed. The  
61 second, released near the putative end of the pandemic in December of 2022, asserted that  
62 the risk of COVID vaccine boosters in young men exceeded their benefit. Both espoused  
63 denialist viewpoints and both had major impacts on public opinion and public health policy.  
64

65 **Denialist Assertion 1: The Lockdowns Were Unjustified**

66

67 On 3 March 2020, the World Health Organization estimated that COVID had a case fatality  
68 rate (CFR) of 3.4% [3]. The specter of tens of millions of deaths and many times that number  
69 of hospitalizations impelled governments worldwide to restrict everything from travel to  
70 school openings. We will never know exactly how many lives 'lockdowns' saved, but they  
71 threatened a broad range of industries, giving rise to many motivated amplifiers. Prominent  
72 among them was the air travel industry.

73 On 17 March 2020, a Stanford epidemiologist argued that "the vast majority of infections  
74 due to SARS-CoV-2 are being missed" and the true CFR was between "0.05 and 1.0%".  
75 COVID, he suggested, might be no worse than the flu [4]. A week later, two colleagues at  
76 Stanford published an op-ed in the *Wall Street Journal* arguing that the CFR could be off by  
77 "orders of magnitude" [5]. The denialists had declared themselves.

78 To prove their point, the Stanford team conducted a seroepidemiology study [6], which  
79 estimated incidence and concluded that, in the pre-vaccine era, the CFR was 0.17%, a



80 reduction of 95% from the WHO estimate. The paper played a central role in supporting the  
81 assertion that COVID is no worse than the flu, meaning the economic impact of the  
82 'lockdown' could not be justified. On 15 May 2020, BuzzFeedNews published the revelation  
83 that the founder of JetBlue provided key funding for the study, a connection the authors first  
84 omitted, then denied, then dismissed as irrelevant [7].

85 That paper's Altmetrics score [8], among the top 5% of all preprints in the life sciences,  
86 reflected 368 reports in the conventional media, including an opinion piece in the *Wall Street*  
87 *Journal* by a hedge fund manager (who, for unspecified reasons, was a co-author of the  
88 seroepidemiology study) [9]. Twitter exploded with 20,277 Tweets (and counting).  
89 Controversy sells.

90 Serious epidemiologists had major concerns about the study, particularly with respect to  
91 selection bias and the potential impact of false positives, and immediately posted them to  
92 Twitter [10]. Unfortunately, trying to have a serious discussion of science on Twitter is like  
93 playing football with the fans on the field. According to Altmetrics, 94% of tweets were from  
94 non-scientists.

95 Peer review did not fare much better than Twitter at catching the study's flaws when it  
96 was published a year later in the *International Journal of Epidemiology*, a journal with one  
97 of the senior authors on its editorial board.

98 So, the research was amplified and denialist, but was it misinformation? Ignoring the  
99 fact that the CFR estimate of 0.17% was based on an unvaccinated population, the 1.13  
100 million COVID deaths confirmed to date in the US would represent 650 million infections,  
101 almost twice the US population. Accounting for deaths prevented by the vaccine [11] could  
102 put the inferred number of cases over 2 billion, which suggests that the study's estimate of  
103 CFR could be off by a factor of 8 or more.

104

### 105 ***Evolution of Contrarian Amplification During COVID***

106 This early episode of COVID amplification of denial was extremely effective and there were  
107 clear connections between amplifiers and the authors. Over the next three years opponents of  
108 lockdowns built a network of organizations with more opaque funding, such as the  
109 Brownstone Institute [13], The Urgency of Normal [14], and Collateral Global [15] to gather  
110 and promote denialist voices [16]. Conservative media outlets regularly interviewed denialist  
111 scientists [17]. The Trump Administration brought them in as advisors [18]. The American  
112 Institute for Economic Research, with its network of donors that includes Charles Koch, a  
113 major funder of climate change denialists, provided the forum for creating and amplifying  
114 the anti-lockdown Great Barrington Declaration with the senior author of the Santa Clara  
115 Study as one of three authors [19], [20]. Throughout, amplifiers identified and supported  
116 researchers with affiliations and degrees suggestive of great expertise and presumably  
117 genuine beliefs about COVID that align with libertarian, anti-lockdown thinking.



118 The urgent demand for pandemic information and divisive politics made social media a  
119 perfect tool for amplification of denial. At the same time, the conventional media, in seeking  
120 to present a balanced perspectives on important issues, solicited input from denialists,  
121 creating the illusion of substantial scientific uncertainty. In our second example, even the  
122 scientific publishers became part of the mix.

123

124 **Denialist Assertion 2: The vaccine causes more harm than good**

125

126 Vaccines had long been a soft target for denialists [21], [22]. In August of 2022, a medical  
127 anthropologist and a team of six co-authors published an essay which argued that restricting  
128 activity “based on COVID-19 vaccination status impinges on human rights, promotes  
129 stigma and social polarization, and adversely affects health and wellbeing” and, as a result,  
130 undermine “trust in scientific institutions” [23]. The authors encouraged “social and  
131 behavioral scientists, bioethicists, epidemiologists, legal scholars, and others to assess the  
132 benefits and harms of COVID-19 vaccination policies.” Within four months, four of the  
133 authors had joined with four new co-authors, three of whom were physicians with prior  
134 clearly stated opposition to public health mandates [24]–[29], to produce the called for Risk  
135 Benefit Assessment (RBA) with exactly the results they had anticipated [30].

136 To the non-scientist, their paper might appear to be above reproach. This team has  
137 affiliations with five of the world’s top ranked institutions for studying infectious diseases  
138 [31]. It was published in a peer-reviewed affiliate of the British Medical Journal.

139

140 But let’s take a closer look. The three physicians primarily responsible for the RBA got  
141 credibility in infectious disease primarily through proximate expertise. Although their  
142 institutions have strong programs in infectious disease, none of them had a direct affiliation  
143 with those programs nor a background in infectious disease epidemiology prior to COVID.  
144 All three were also connected to motivated amplifiers including the Brownstone Institute,  
145 which has been a supporter of a senior author from the Stanford team [32]. Another has  
146 received major funding from the Arnold Foundation, which has also supported a senior author  
147 of the Santa Clara Study [33]. The team member who “researched the inputs for the risk-  
148 benefit analysis, performed the computations, and created the visuals,” works, according to  
149 her own website, for a “Boutique science and technical communications consultancy” [34].

150 But was it Misinformation? The credentials, funding sources, and past behavior of the  
151 authors should not prejudice assessment. However, a review of their methods reveals glaring  
152 irregularities. First, note that they cited, but ignored an existing RBA from CDC [35], which  
153 estimated that the booster was preventing 114 hospitalizations for every seven



154 hospitalizations it caused in this group. Second, they didn't even cite a far more  
155 comprehensive RBA by leading British epidemiologists, data scientists, and virologists [36],  
156 which also found benefits dramatically exceeded risks in adolescents. Second, consider the  
157 authors' decisions in estimating risks and benefits. (Note that all information cited is from  
158 either CDC websites or the authors' own references).

159

160 **Risks:**

161 1. Their highest estimate of myopericarditis risk for men aged 18-29 of 14.7/100,000  
162 (95% CI 4.0-37.6), was based on just four cases [37], included men up to age 39,  
163 and was just a subset of data from a much larger CDC study [38].

164 2. In reporting data from that larger CDC study, they simply ignored risks in the  
165 control group and reported the absolute risk of 4.8/100,000 rather than the excess  
166 risk of 3.2/100,000 [35].

167 3. They also ignored a large Israeli study [39], which estimated myopericarditis risk  
168 from the booster as 2.0/100,000 in men aged 20 to 29. They instead chose a much  
169 smaller Israeli study [40] from a brief research letter, listing a risk of 12.7/100,000  
170 [the source of which is unclear, given the published estimate of 11.3/100,000 (95%  
171 CI, 2.92-19.59)]. Note that this is again absolute, not excess risk.

172 4. They ignored control data for reactogenicity [41] and serious adverse events [41],  
173 which, in both cases, showed higher rates of morbidity than the booster group.

174 5. They equated COVID hospitalizations to post-vaccination reactogenicity and  
175 serious adverse effects, the definitions of which explicitly exclude almost all  
176 hospitalizations [30].

177

178 **Benefits:**

179 1. Despite evidence in the authors' own references that the booster reduced the  
180 incidence of symptomatic disease by 93-95% and dramatically reduced rates of  
181 asymptomatic infections [35], [41], [42] they assumed the booster provided no  
182 reduction in secondary transmission, symptomatic disease, or long COVID [43].

183 2. The only benefit they ascribed to the booster was a decrease in hospitalizations of  
184 only 6.4/100,000 for 18-29-year-old men, which, given the prevailing rate of US  
185 hospital admissions in this age group was 150/100,000 per 6 months, [44]  
186 corresponded to a presumed vaccine efficacy of 4%. The CDC estimate at the time  
187 was that the booster reduced hospitalization rates by 91% [41].

188 3. Despite reduced hospital admissions, they assumed no reduction in mortality even  
189 though there were 3.3 deaths/100,000 in the US during this period for this age group  
190 [45].



- 191 4. Despite evidence the vaccine had an efficacy at 6 months of 50-90% [35], they  
192 assumed the vaccine provided no benefits after 6 months.  
193 5. They ignored the benefits of the bivalent booster [46].  
194

195 In sum, in each of the cases described above, the authors made choices that maximized risk  
196 and minimized or ignored benefits from the booster. It seems highly unlikely that this reflects  
197 random error. (Note that when I pointed out the problems listed above to the journal editors,  
198 I received an email informing me that “it’s clear that the authors haven’t maximized the risks  
199 of vaccination nor minimized the risks associated with Covid” [47], a statement of surprising  
200 confidence for someone with no training in medicine, laboratory science, or epidemiology.)

201 Even if any of these choices were justifiable, most were made without explanation or  
202 even acknowledgment. This pattern suggests a profound disregard for fundamental scientific  
203 principles. Contrarianism without self-skepticism is advocacy, not science.  
204

### 205 **Journals as Amplifiers of Denial**

206  
207 How could this team publish such a deeply flawed RBA in an epidemiology or public health  
208 journal? The solution was to avoid the epidemiological journals entirely, choosing instead the  
209 *Journal of Medical Ethics (JME)*. A review of papers published in *JME* during the pandemic  
210 reveals no other original epidemiology. There are several papers by the authors of the RBA,  
211 including one titled, “How to Hold an Ethical Pox Party”[48], published by its corresponding  
212 author. Of the five previous papers considering the ethics of vaccine mandates, all argued  
213 that they were, in some way, unethical [49]–[53].

214 The Editor-in-Chief is President of the National Ethical Advisory Council in New  
215 Zealand, which published a report in 2007 on preparing for pandemics. That report cautioned  
216 against mandates in almost every mention of vaccines [54]. In 2021, with New Zealand  
217 imposing bold, highly effective COVID intervention policies [55] he published an open letter  
218 arguing against a rule requiring vaccinations for anyone participating in a clinical trial [56].

219 Not only does *JME* seem receptive to arguments against vaccine mandates, but it also  
220 seems receptive to denialist science. A Senior Editor had just published an essay [57] arguing  
221 that a tendency on the part of medical researchers to assert unwarranted confidence in their  
222 findings often evolves into a medical orthodoxy that excludes opposing viewpoints. In the  
223 face of what he called “Broad Medical Uncertainty,” he argued dissenting viewpoints must  
224 be heard. In this case, it appears that denialist voices were amplified with a marked lack of  
225 critical review.  
226

### 227 **Social Media and the Amplification of Denial**

228



229 Given the kernel of truth in the evidence of vaccine related myocarditis risks, there are  
230 important ethical discussions to be had, but the authors' representation of the paper on social  
231 media focused almost exclusively on the RBA and the tremendous attention it was receiving  
232 on Twitter [30], [58]–[64].

233 Twitter has long been the platform of choice for scientists discussing science [65] but  
234 existing efforts to filter misinformation have been largely abandoned [66]–[68]. The RBA of  
235 vaccines in adolescents by a team of 15 British subject matter experts had 867 tweets at the  
236 time of this writing [36]. The denialist paper has over 53,700 tweets giving it the 2<sup>nd</sup> highest  
237 Altmetrics score in the history of *JME*.

238 The research community has become increasingly connected to the larger 'attention  
239 economy', a term introduced in 1971 by Herbert Simon to characterize the growing market  
240 for human attention, which has risen steadily in importance since the advent of social media.  
241 Altmetrics scores [69], essentially a measure of attention, have become a ubiquitous measure  
242 of papers' perceived significance despite its heavy dependence on merely counting Tweets.  
243 The scientific community's embrace of Twitter<sup>59</sup> (now X) as an indicator of import is  
244 astonishing given the features that make it uniquely ill-suited to meaningful discussion of  
245 science. Imagine a scientific conference in which comments are limited to 240 characters,  
246 95% of the people in the room are non-scientists, anyone in the audience can show a slide  
247 whenever they want (but only one at a time) and the microphones go to celebrities.

248 Even a citation index is heavily influenced by controversy and the attention it generates.  
249 Controversial papers get cited even if only to refute their findings. In other words, the  
250 scientific journals themselves tend to be denialist amplifiers.

251

### 252 **Amplifying the Prevailing Scientific Perspective**

253

254 The assessment of information is based on trust rather than any specific indicator of accuracy  
255 [70]. A Pew Foundation survey in April of 2020 found that the single most reliable source  
256 for health information were medical scientists with 89% of respondents expressing "a great  
257 deal" or "a fair amount" of trust in scientists to act in the best interests of the public. [71].  
258 The amplification of denialists, which goes far beyond the two papers mentioned here, not  
259 only gave unwarranted prominence to their minority opinion, it appears to have undermined  
260 trust in medical scientists, which by October of 2023, had dropped to 73% [72].

261 From the perspective of sheer volume, the bulk of COVID misinformation involved  
262 blatant falsehoods and conspiracy theories [73] spread by trolls, bots, and content polluters  
263 with little or no connection to scientific papers [74]. Proposed strategies for addressing  
264 misinformation have tended to focus on either public rebuttal of misinformation [75] or some  
265 form of public education [76]. Neither, however, addresses the challenge posed by  
266 amplification of denial: how to provide balance by amplifying the collective perspective of





267 subject matter experts in the scientific community. A necessary first step is to build a forum  
268 for that community with the explicit intention of capturing that perspective.

269 This forum must include strategies for:

- 270 • **Assembling the Evidence:** The central goal of any such forum is to bring together  
271 and summarize the weight of the evidence such that no individual study can be  
272 taken out context and no individual voice can be artificially amplified.
- 273 • **Establishing Public Credibility:** To have credibility, this forum must have initial  
274 buy-in from a highly regarded scientific organizations, institutions, and funders.
- 275 • **Preventing Twitterization:** Any online platform faces the same risks as existing  
276 platforms. That is, how to avoid being distorted by amplification of denial. At a  
277 minimum, this will require keeping the fans off the field by defining and requiring  
278 participant expertise. Also, participants must follow rules of engagement agreed to  
279 by the community.
- 280 • **Incentivizing engagement:** This may be the most difficult challenge to creating  
281 such a forum. Scientists are busy and operate in a prestige economy. Any such  
282 platform must include a system for acknowledging the contribution of participants  
283 and the reaction of their peers to that contribution.

284

285 These are serious challenges, but they are no more daunting than the current, losing game  
286 of scientific Whack-a-Mole that defines individual efforts to debunk misinformation. The  
287 point is not to replace popular social media, but instead to provide a forum or platform that  
288 captures the collective voice of public health experts and can be shared on social media, while  
289 minimizing noise and distortion.

290

## 291 **Conclusions**

292 Contrarian Amplification predates COVID, but the unique nature of the pandemic elevated  
293 it to an entirely new and dangerous level. The discussion above identifies four factors that  
294 artificially amplified denialist voices.

- 295 1. **Motivated Amplifiers:** Motivated amplifiers are individuals or organizations  
296 seeking to protect or promote their interests in opposition to the prevailing scientific  
297 perspective who provide support, financial or otherwise, for denialists.
- 298 2. **Conventional Media Presenting “Balance”:** The media routinely seeks to present  
299 both sides on an issue, effectively amplifying denialists and creating the illusion of a  
300 significant split within the research community.
- 301 3. **Marketers and Promoters of Controversy:** Controversy sells, consensus does not.  
302 In an attention economy many outlets, including scientific journals, amplify  
303 denialists simply for the attention they generate.



304 4. **Structural Amplifiers:** The silos of social media can create environments in which  
305 the denialist voices can dominate and consensus views can be so minimized that  
306 they appear to represent a radical fringe. The voices of subject matter experts are  
307 lost in the noise of social media.

308

309 The instantaneous, seamless reach of the internet makes amplification of denial an inherently  
310 global problem, not limited to any one country.

311

312 Skepticism and dissent are essential to scientific progress, but artificial amplification of  
313 denialism undermines the process. Their artificial amplification in the media, particularly the  
314 social media, poses an existential threat to public health science. We need to create a forum  
315 for researchers where, in the bright glare of scientific scrutiny, misinformation goes to die.



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