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An epidemic of uncertainty: rumors, conspiracy theories and vaccine hesitancy

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The COVID-19 'infodemic' continues to undermine trust in vaccination efforts aiming to bring an end to the pandemic. However, the challenge of vaccine hesitancy is not only a problem of the information ecosystem and it often has little to do with the vaccines themselves. In this Perspective, we argue that the epidemiological and social crises brought about by COVID-19 have magnified widely held social anxieties and trust issues that, in the unique circumstances of this global pandemic, have exacerbated skepticism toward vaccines. We argue that trust is key to overcoming vaccine hesitancy, especially in a context of widespread social uncertainty brought about by the pandemic, where public sentiment can be volatile. Finally, we draw out some implications of our argument for strategies to build vaccine confidence.

It has now been 2 years since the World Health Organization (WHO) declared that, alongside the COVID-19 pandemic, it was also fighting an 'infodemic' — an "overabundance of information, both online and offline"[1]. One index of the scale of this infodemic was that during April 2020, Twitter reported seeing a COVID-19-related tweet every 45 milliseconds[2]. The huge cascade of viral misinformation that has formed part of the COVID-19 infodemic has included conspiracy theories about the origins of the virus as well as suspicions around the motives behind government COVID-19 control measures. In this Perspective, we discuss the new digital communications landscape in relation to vaccines, emphasizing the role of trust in overcoming hesitancy and building vaccine confidence beyond the current pandemic.

The vaccine misinformation landscape

Rumors and conspiracy theories around COVID-19 vaccines have undoubtedly been damaging. Research conducted by the Vaccine Confidence Project in 2020 aimed to quantify how exposure to online misinformation around COVID-19 vaccines might be affecting vaccination intent[3]. As part of a randomized control trial conducted in the United Kingdom and United States, participants were exposed to examples of misinformation circulating on Twitter, including one post falsely claiming that a COVID-19 vaccine would alter DNA in humans and another falsely claiming that a COVID-19 vaccine would cause 97% of recipients to become infertile. The study found that, relative to factual information, these items of misinformation induced a decline in intent to vaccinate. In the United Kingdom, there was a 6.2 percentage point drop in the respondents who 'strongly agree' that they would get vaccinated, alongside a 6.4 percentage point drop in the same response among US respondents. Other studies have reached similar conclusions about the effect of exposure to online vaccine misinformation[4].

Until shortly before the pandemic, most social media platforms had few if any policies to address vaccine misinformation. In early 2019, in response to a series of measles outbreaks in the United States, Facebook announced for the first time that it would reduce the ranking of groups and pages promoting vaccine misinformation in its news feed and search tool[5]. It further pledged to reject advertisements that included misinformation about vaccines and to stop showing or recommending such content on the Explore and hashtag pages on Instagram, which Facebook owns. Around the same time, YouTube began to prevent anti-vaccination channels from raising money through advertisements[6]. However, these measures typically stopped short of removing misleading content. In July 2020, an investigation by the Center for Countering Digital Hate, a UK-based campaign group, found that avowedly anti-vaccination accounts on English-language social media had a combined 58 million followers, which it estimated could be worth up to US$1 billion a year to the platforms[7].

Since the pandemic began, social media companies have come under increasing public and political pressure to prevent misinformation spreading on their platforms. Facebook, Instagram, Twitter and YouTube all now have explicit policies regarding COVID-19 and vaccine misinformation more broadly. Typically, these involve a combination of signposting users to credible information sources, placing warning labels on potentially misleading information and removing content that has the highest risk of causing real-world harm. Facebook, the world's largest social media platform, claimed that by August 2021 it had removed over 3,000 accounts, pages and groups since the beginning of the pandemic for repeatedly violating its rules against spreading COVID-19 and vaccine misinformation, along with 20 million individual pieces of content[8].

Recent interventions demanded of social media companies raise major questions around whether private technological monopolies have both the democratic legitimacy and the institutional competence to arbitrate the scientific merits and likely real-world consequences of speech acts within the digital public sphere. More to our point, the shared focus on technological solutions by both platforms and critics urging them to go further in removing misinformation implies that vaccine hesitancy is still widely seen as primarily an informational problem, rather than a trust problem. This diagnosis already implies a cure: reduce the supply of false information and increase the supply of accurate information. However, increasing the supply of accurate information will not, on its own, 'cure' this problem if the underlying drivers of hesitancy remain unaddressed.

The role of social uncertainty

Rumors and conspiracy theories about COVID-19 and vaccines should not be understood simply as false beliefs. Instead, they can

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be read as expressions of popular fears and anxieties. These narratives typically emerge in times of acute social uncertainty. In the historical literature, modern conspiracy culture is generally traced back to the immediate aftermath of the French Revolution, which was attributed by some contemporary observers to the machinations of secret societies such as the Freemasons or the Bavarian Illuminati[9]. Conspiracy theories similarly flourished after the Russian Revolution, when the idea of an international Judeo–Bolshevik conspiracy became popular in Europe and North America, and in the United States during the early part of the Cold War, when the rising threat of Soviet communism led to the second Red Scare.

Conspiracy theories represent attempts to impose narrative coherence on frightening situations such as revolutions, wars, financial crises, natural disasters or pandemics. Their ubiquity in late-twentieth and early-twenty-first century politics and culture has been linked to popular anxieties around globalization, new technologies, socioeconomic inequality, terrorism and increased surveillance, among other things[9]. They are often brought to the fore by historic events such as the terrorist attacks of 11 September 2001, the financial crisis of 2008, and the current COVID-19 pandemic. Notably, social psychologists Jan-Willem van Prooijen and Karen Douglas have argued that while conspiracy theories may emerge through the desire to make sense of one's social environment in a context of uncertainty, their distillation of "complex events into a simplified story… makes such theories ideally suited for cultural transmission as they are easily understood by lay people"[10].

Although many of the anxieties fueling COVID-19 rumors and conspiracy theories long predate the pandemic, they have probably been exacerbated by the widespread social uncertainty of the past 2 years. For instance, health scares around new technologies, from high-voltage power lines and microwaves to mobile phones, are nothing new. Moreover, conspiracy theories about 5G mobile technology specifically — for example, that it was responsible for the unexplained deaths of birds and trees — were already circulating in the years leading up to the pandemic. It is perhaps unsurprising that in the unique circumstances of early 2020 these anxieties began to be linked to COVID-19 after a Belgian physician drew a connection between the construction of 5G mobile towers in Wuhan and the novel coronavirus outbreak[11]. The myth spread first among fringe communities on social media, before being picked up and amplified by celebrity influencers and media outlets[12]. It is estimated that in a 4-day period in early April 2020, at least 20 mobile phone masts were vandalized in the United Kingdom alone by people convinced that 5G was responsible for spreading COVID-19 (ref. [13]).

Similarly, that one-fifth of Americans believe that COVID-19 vaccines are being used by the government to microchip the public shows how widespread concerns about digital surveillance and the commodification of personal data (including highly sensitive medical data) have become[14]. Again, these concerns long pre-date the pandemic and have been fueled by high-profile news stories such as the 2018 Facebook–Cambridge Analytica data-collecting scandal; however, they came to the fore during the first half of 2020 as many governments sought to harness technologies developed by the private sector, especially mobile phone data, to tackle the spread of COVID-19. Concerns about the growing and often unscrutinized role of biosurveillance as a means of controlling the pandemic are by no means confined to the political fringe. But for some who felt their lives were increasingly being controlled by the state or by remote elites, Bill Gates came to serve as the perfect scapegoat owing to his combined roles as technological innovator, capitalist entrepreneur and pro-vaccine philanthropist.

The importance of trust
A dysfunctional information ecosystem may have accelerated the spread of COVID-19 myths and conspiracy theories but, as the thumbnail history of conspiracy thinking sketched above suggests,

it did not directly cause them. Rumors around vaccine safety were being communicated via traditional media long before digital technologies were available to amplify them; for instance, in the scare around the diphtheria, pertussis and tetanus vaccine during the late 1970s and early 1980s, which was fueled by mainstream newspaper and television coverage[15]. Moreover, although the information ecosystem is undoubtedly an important influence on vaccine decision-making, as our recent research on the impact of misinformation exposure demonstrates, focusing only on the information ecosystem can obscure the wider sociocultural, historic, institutional and political context.

In many countries, a lack of trust in key institutions involved in the production, supply and distribution of vaccines is a crucial part of that context. Several studies have found evidence of a link between vaccine hesitancy and 'populist' distrust of political elites and medical experts. For example, a 2019 study of European Union member states found a marked positive association between electoral support for populist parties and low confidence in vaccine importance and effectiveness[16]. A similar study in the United States in 2018 found that vaccine attitudes, trust in public health experts and political worldview were all interlinked[17]. Other studies have found that measures of trust in politicians closely predict conspiracy belief[18,19].

Trust can be conceptualized as "a relationship that exists between individuals, as well as between individuals and a system, in which one party accepts a vulnerable position, assuming the best interests and competence of the other, in exchange for a reduction in decision complexity"[20]. Trust becomes important whenever there is "an implicit imbalance of power due to a high level of information asymmetry, where trusting individuals accept a vulnerable position in relation to a trusted party"[20]. It is especially important in a context of social uncertainty, such as during a public health crisis, when individuals often have to make crucial decisions on the basis of incomplete information. In relation to vaccine acceptance, multiple dimensions of trust are important. There needs to be trust in the product (the vaccine itself), in the provider (those administering immunizations such as healthcare professionals) and in the policy-maker (health systems, government officials, public health researchers and others).

The COVID-19 pandemic and associated infodemic have magnified the underlying problem of trust. The ebb and flow of pandemic waves, together with policy uncertainty and information overabundance have all increased the complexity of decision-making. Rumors and conspiracy theories can contribute to this epistemic uncertainty regardless of whether people believe them or not. As research shows, even if individuals distrust anti-vaccination content, exposure to these narratives can still sow doubt about the safety and efficacy of vaccines or about the motives of those involved in their manufacture and administration[21].

Trust is often linked to past experiences, which is one reason why marginalized groups, such as religious and ethnic minorities, have been found to be less trusting of vaccines in general and less likely to vaccinate[22]. For example, vaccine hesitancy among Black communities today reflects historical distrust of public authorities and healthcare providers, among other factors[23]. This distrust is related to a long history of structural racism and medical abuses against Black populations, often compounded by negative personal experiences with healthcare systems and providers. Genuine concerns such as these are often susceptible to exploitation, for instance in the United States where figures connected with the Black Nationalist Nation of Islam have actively been promoting vaccine misinformation to African American audiences through a network of social media accounts[7].

While much has been said about vaccine hesitancy among minority groups, the institutional failures that have led to these attitudes often receive less attention. For example, conspiracy theories

about COVID-19 vaccines have found fertile ground in Nigeria, partly due to collective memories of a controversial 1996 drug trial conducted during a meningitis outbreak, in which 11 children died and many more developed life-changing disabilities[24]. Pfizer, the company responsible for the trial, insisted that it obtained approval from the authorities and verbal consent from participants before the study, and claimed that the symptoms and deaths were due to meningitis, not the drug itself. Following legal action by the Nigerian authorities, Pfizer reached an out-of-court settlement in 2009, without admitting liability. However, a widespread perception that the company had behaved unethically likely contributed to susceptibility to believing the vaccine rumors that led to a 2003 boycott of a polio vaccination campaign in three northern Nigerian states[25]. Given the historical context, it is perhaps unsurprising that 55% of Nigerians believe it is 'definitely' or 'probably' true that harmful side effects from vaccines are deliberately being concealed from the public, according to a YouGov poll conducted in mid-2020 (ref. [26]).

The volatility of sentiment

In a context of widespread social uncertainty, sentiment can often be volatile[27]. While the broad picture is that vaccine willingness has been on the increase since late 2020, around the time Pfizer announced it had a highly effective COVID-19 vaccine, the global trend masks considerable geographical and temporal variation. In some countries, sentiments fell sharply in spring 2021 in the context of safety concerns around the AstraZeneca vaccine[28]. An extreme example is Thailand, where YouGov polling found that COVID-19 vaccine willingness declined from 83% at the start of 2021, to 60% in mid-March when a number of countries temporarily suspended use of the AstraZeneca vaccine, before climbing to 95% by the end of that year[29].

'Emotional epidemiology', a term coined by Danielle Ofri in the context of the 2009 H1N1 pandemic, describes these sharp fluctuations of sentiment that often attend the discovery of new illnesses[30]. The term encapsulates how health decisions are not only determined through rational thinking, but are equally impacted by a variety of feelings[31]. Fears and anxieties related to COVID-19 are known to have impacted the pandemic response on a global scale, fueling vaccine hesitancy in different parts of the world[32]. Similarly during the outbreaks of Ebola in West Africa, fears and anxieties had negative effects on preventive behaviors such as isolation and also increased stigmatization of those who were sick[33]. Conversely, positive emotions, such as hope for a return to normality, may motivate people to comply with public health measures[34,35]. Altruism can drive individuals to participate in risky clinical trials, with highly uncertain outcomes, to help their communities[36].

Like misinformation, emotions are entangled with broader political and societal issues. Emotions can also be experienced collectively, driving larger group trust levels and action. These large-scale affective processes cannot be fully grasped in individual analyses[35]. Past collective experiences can drive groups to internalize shared emotions that might influence acceptance or rejection of health interventions or guidelines[37]. Given the scale at which COVID-19 is affecting the world, and the extent to which digital media have accelerated both informational and emotional flows since Ofri was writing in 2009, the emotional drivers of trust and confidence in different health interventions are becoming an increasingly important area of research[36].

Building vaccine confidence

Recognizing vaccine hesitancy as being primarily a trust issue rather than an informational problem, and one that has emotional as well as rational determinants, has several implications for health policy and communication. In the first place, politicians and medical experts need to be mindful of the distinction between vaccine hesitancy and being anti-vaccine[27]. Especially in a context of uncertainty, when sentiments are volatile, vaccine hesitancy is better conceived of as a decision-making process rather than a fixed set of beliefs, attitudes and behaviors[38]. Moreover, being indecisive in a situation of uncertainty is not the same thing as being 'anti-vaccination'[27]. As described above, hesitancy can have various causes, ranging from historic community experiences to safety concerns around COVID-19 vaccines. Hesitant individuals are often consumers of anti-vaccination content, but this does not mean that they are ideologically opposed to vaccination.

Communication about vaccines should start from a position of empathy and aim to rebuild trust. This requires working through trusted messengers and established relationships. For instance, training community health workers from the local communities was an important part of the Ebola response. Such initiatives are arguably even more important in the context of the COVID-19 pandemic when national political leadership has often been found wanting. One recent and particularly bold initiative is the New Zealand government's collaboration with gang leaders to promote COVID-19 vaccines to hard-to-reach communities, in an effort to overcome ethnic disparities in uptake[39].

Conversely, politicians and public health authorities should carefully weigh the risks when considering measures that could potentially be perceived as coercive or stigmatizing by hesitant communities and individuals. For example, recent research by the Vaccine Confidence Project on public attitudes toward COVID-19 vaccine passports in the United Kingdom found that, although in overall terms vaccine passports had a positive effect on vaccine intent, the effect was polarizing. Passports made those who already intended to get vaccinated even more positive toward it, but had the opposite effect on those who had concerns about the vaccine[40]. Notably, it was among groups with lower uptake, including Black communities, that the effects of domestic vaccine passports were most negative. This is likely linked to longstanding suspicions of medical interventions, derived from historical experience, as described above.

Although the emphasis should be on building trust, measures to tackle misinformation still have an important part to play. There has been a recent and welcome shift in emphasis from reactive measures such as content removal and fact-checking by social media companies, to more proactive ones that seek to build resilience against potentially harmful ideas before people are exposed to them. This is backed up by research showing that it is possible to confer psychological resistance to misinformation through a combination of forewarning and pre-emptive refutation ('pre-bunking')[41]. Approaches can range from individual-level interventions to build resilience against misinformation, such as the 'Bad News' game (http://www.getbadnews.com) to societal-level initiatives to promote health and media literacy through school curricula as is being conducted successfully in Finland[42,43].

Conclusion

It is important to recognize that some of the factors fueling vaccine hesitancy, such as anxieties around the pace of technological change or feelings of political disempowerment, are not within the control of the medical community. As the example of health and media literacy initiatives in schools suggests, addressing such issues will require a long-term effort on the part of multiple stakeholders working across several sectors of society[43]. Like the virus that gave rise to them, it seems probable that myths and conspiracy theories around COVID-19 and vaccines will be things that we all need to learn to live with and manage for some time to come. In this new landscape, the best measure of progress toward building vaccine confidence for the longer term is perhaps not the number of doses administered so far, but public trust in the institutions responsible for delivering them.

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