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Open knowledge commons versus privatized gain in a fractured information ecology: lessons from COVID-19 for the future of sustainability

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Abstract

COVID-19 has shone a bright light on a number of failings and weaknesses in how current economic models handle information and knowledge. Some of these are familiar issues that have long been understood but not acted upon effectively – for example, the danger that current systems of intellectual property and patent protection are actually inimical to delivering a cost-effective vaccine available to all, whereas treating knowledge as a commons and a public good is much more likely to deliver efficient outcomes for the entire global population. But COVID-19 has also demonstrated that traditional models of knowledge production and dissemination are failing us; scientific knowledge is becoming weaponized and hyper-partisan, and confidence in this knowledge is falling. We believe that the challenges that COVID-19 has exposed in the information economy and ecology will be of increasing applicability across the whole spectrum of sustainability; sustainability scholars and policymakers need to understand and grasp them now if we are to avoid contagion into other sectors due to the preventable errors that have marred the global response to COVID-19.

Social media summary

COVID-19 highlights both the failures of privatized knowledge and worrying fractures in the wider information ecology.

1. Introduction

The COVID-19 pandemic has shone a bright light upon the decisions and actions of governments, corporations, health systems and populations. Millions have been infected and hundreds of thousands have died in the months since knowledge of the SARS-CoV-2 coronavirus became widespread. Information and knowledge – good or bad, shared or withheld – have been central to the evolution of the pandemic and our responses to it. These challenges are not new; their persistence and rapid re-emergence in this global crisis suggest strongly that current policy and economic models have failed to address their root causes. In this Intelligence Briefing, we argue that expanding existing models of open-source and commons knowledge will be critical not only to combat present and future pandemics, but also to support the actions and collective investments required to safeguard human and planetary health and sustainability. Not surprisingly, these models will have far-reaching consequences for established economic and business models. However, COVID-19 has also revealed concerning fractures in the broader scientific and information ecologies, which have not only impeded the response to the pandemic, but may bode ill for science-based policy and decision-making in all fields of sustainability.

2. The economics of proprietary versus open knowledge in the pandemic

Knowledge, information and uncertainty have been central to the story of COVID-19 so far, as have long-standing tensions between collaboration and competition. Heroic efforts have been made to share the results of initial research widely and freely, including the genomic sequence of the virus itself, clinical and epidemiological data, patterns and designs to allow local 3D printing of personal protective equipment (PPE) items and ventilator components and international efforts to develop vaccines. And, of course, much still simply remains unknown about COVID-19. Yet accusations and counteraccusations fly as to whether China was transparent enough in its release of data early in the pandemic, while the USA's actions undermine the

ability of the World Health Organization (WHO) to share reliable information; the limitations of peer-reviewed and open-access journal publishing as a vehicle for rapid dissemination of validated and reliable scientific results are yet again on display; while disinformation and conspiracy theories have run riot worldwide. This is to say nothing of the unseemly scramble between nations to source key physical supplies such as PPE and ventilators, ranging from bidding wars to the use of intelligence agencies to secure supplies ahead of other nations, as well as allegations of cyberespionage to steal information on promising candidate vaccines.

Indeed, COVID-19 provides a useful lens on questions of *scarcity* that are likely to recur across the terrain of planetary health in the years to come. From the perspective of economics, a resource is scarce if the quantity available is insufficient to satisfy all demands, which must then compete for access. Only scarce resources have market value, and markets allocate them to the highest bidder. Growing demand for many essential physical products – some as simple as facemasks and hand sanitizer – called attention to their scarcity even in wealthy nations. The revelation of the limitations of physical supply chains has been an unwelcome and unsettling intrusion into the worldviews of both industry and consumers. Meanwhile, this crisis has only worsened the ever-present problem of real resource scarcity in the world's poorer societies. We would do well to take note of these lessons. Global supply chains are increasingly likely to be vulnerable to disruption from intersecting environmental, social and economic crises. More immediately, fears are growing over near-term risks of extreme food shortages and famine in several regions, as COVID-19, conflict, extreme weather and crop pests interact (FSIN, 2020).

Even while the recent re-emergence of physical scarcity under COVID-19 has come as a shock to the rich world, for many decades conditions of *artificial* scarcity have been induced as a deliberate aim of economic policy. Existing knowledge is not scarce, since use by one person does not leave any less available to others; knowledge, in fact, improves with use. One reason that masks are scarce, as Stiglitz *et al.* (2020) have pointed out, is the 441 patents owned by 3M that mention 'respirator' or 'N95'. Patent and intellectual property protections – the granting of monopoly rights, the antithesis of market competition – have, under conventional economic wisdom, been viewed as necessary to incentivize innovation. Innovations – whether new drugs and vaccines, robots or software – incur high upfront fixed costs, but then have a low (or, in the case of information, zero) marginal cost of production. It costs an estimated average of US$2.6 billion to bring a new drug to market (DiMasi *et al.*, 2016) and an estimated US$319–469 million to take a vaccine from preclinical trial to Phase 2a of clinical trials (Gouglas *et al.*, 2018), which are now underway for the most advanced potential COVID-19 vaccines, but with no guarantee of success. Yet it may cost only pennies to manufacture the resulting vaccine. The more units produced, the lower the average total cost of production. Firms competing to develop COVID-19 vaccines inefficiently replicate fixed costs, and if several are successful, each firm will have to charge more to earn a profit. High fixed costs and low marginal costs are characteristic of natural monopolies, including most public utilities (water, electric or sewage), which are tightly regulated in order to prevent price gouging. Price gouging is particularly problematic for commodities with inelastic demand, such as vaccines and life-saving drugs, for which revenue declines as output increases and profits are maximized by restricting production.

Conventional theory claims that only guaranteed monopoly profits can incentivize entrepreneurial firms to make the investments required to develop new technologies and products (DeLong & Summers, 2001). Yet concerns have been growing for years that traditional patent protections actually slow innovation and increase research costs by forcing researchers to negotiate licensing fees with holders of related patents (including many held by patent trolls), and that these protections reduce social welfare through monopoly pricing (Benkler, 2004; Heller, 1998; Heller & Eisenberg, 1998). Monopoly rents from patents make the pharmaceutical industry one of the most profitable industries globally (Prasad & Mailankody, 2017; Spitz & Wickham, 2012). The profound problems that this model poses to ensuring affordable access to medicine in lower-income countries, for neglected diseases and for vaccines of greatest value to the poor have been well documented over many years (Baker *et al.*, 2017). The higher the price charged for a coronavirus vaccine, the lower the demand, the lower the likelihood of achieving herd immunity and the greater the likelihood that the virus will evolve new vaccine-resistant strains. The public good nature of vaccines – one person's use confers benefits on others – even justifies negative prices. Relying on market allocation systems for a critical vaccine therefore risks failing to generate the information most needed by society to produce it at least cost and will likely keep it artificially scarce even once it is available (Farley & Kubiszewski, 2015),

3. Distortion and rent-seeking in COVID-19 intervention research

In the case of COVID-19, treatments and vaccines are being pursued by a mix of for-profit, often publicly funded firms explicitly seeking patent rights and public or not-for-profit initiatives and collaboratives that may open up successful innovations for open-source manufacture. While genomic information on SARS-CoV-2 has been extensively shared amongst a worldwide network of researchers (*Nature*, 2020), current efforts to develop more than 150 candidate vaccines for COVID-19 are highly fragmented (*Lancet*, 2020). Alongside traditional private-sector efforts, some international collaboratives do exist, yet it is not clear that these will provide open access to either products or intellectual property (*Lancet*, 2020). The availability and affordability of effective COVID-19 interventions may therefore hinge simply on who arrives first – a rather capricious outcome for many. In the USA, Big Pharma has not only successfully lobbied for US$3 billion in government funding to develop treatments for COVID-19, but also for the right to patent the vaccine with no restrictions on the prices they charge (Karlin-Smith, 2020). Oxford University's Jenner Institute provided exclusive licensing for its publicly funded vaccine, currently in clinical trials, to UK-based AstraZeneca, with no commitment to public access (AstraZeneca, 2020).

The governments of several high-income countries have 'pre-ordered' large volumes of vaccine from several of these initiatives, raising questions about whether and when other nations might receive access. For example, the GAVI Alliance has used its COVAX Advance Market Commitment to pre-order 300 million doses of the putative Oxford University–AstraZeneca vaccine for US$750 million on behalf of the world's poorest countries. COVAX is a facility that is open for any country to pool funds for the purchase of vaccines and for donors to direct overseas development assistance towards vaccine purchase for low- and lower middle-income nations (GAVI, 2020). However, the US

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government has also pre-ordered the same quantity from AstraZeneca, albeit for a total cost of US$1.2 billion (Prabhala & Elder, 2020). WHO and others are exhorting vaccine and other manufacturers to share knowledge, intellectual property and data through initiatives such as the COVID-19 Technology Access Pool (WHO, 2020b) and the Open COVID Pledge (opencovidpledge, 2020). Yet COVAX and the WHO's Global Allocation Framework (WHO, 2020a) are silent on intellectual property and implicitly assume market purchasing from existing suppliers. It is notable that the pledgers listed on the Open COVID Pledge website did not, at the time of writing, include any vaccine or pharmaceutical firms.

COVID-19 has already provided significant opportunities for the realization of large economic rents in the vaccines and pharmaceuticals sector. The non-governmental Coalition for Epidemic Preparedness (CEPI), which works alongside GAVI and WHO, granted US$388 million to Novavax, driving a massive jump in its stock price (Nathan-Kazis, 2020) in anticipation of monopoly profits. Executives at Moderna raised eyebrows by arranging for legal sales of stock, timed to take place immediately after encouraging announcements on its candidate COVID-19 vaccine (Egan & Isidore, 2020). Large sums of public funding are also available for candidate treatments for COVID-19, spurring feverish activity by large and small pharmaceutical firms alike, often backed by hedge funds and using technologies licensed from university-based, publicly funded research (Rowland, 2020). One important strand of the surprising controversy over the use of the antimalarial agent hydroxychloroquine in COVID-19 (see Box 1) has been the tension between repurposing old and off-patent drugs (like hydroxychloroquine and the steroid dexamethasone), which offer only limited profit opportunities, and novel agents (such as remdesivir), which offer the prospect of patents and monopoly rents. The willingness of the US government to advance purchase almost all of the manufacturing pipeline of remdesivir for July, August and September will certainly cement these profits for the drug's makers. It is perhaps unsurprising that there has been even less enthusiasm for conducting badly needed research into key social interventions (such as the use of facemasks by the general public or specific aspects of social distancing), which offer even less prospect of future profitability.

Box 1. The hydroxychloroquine roller coaster.

Hydroxychloroquine (HCQ), an antimalarial medication approved for use in 1955, came to prominence after a small French study, published on 20 March 2020, suggested that it had been effective in treating COVID-19 patients. Trials of HCQ proliferated around the world, while US President Donald Trump vigorously endorsed the use of the drug (Saitz & Schwitzer, 2020). Yet a string of contradictory results followed rapidly, some reporting no benefit or even risks of harm from the drug, while others supported its use. Interpretation was complex, as trials investigated many different applications of HCQ in newly diagnosed, mildly ill or severely ill patients, using quite different treatment regimes. In a politicization of pharmaceutical science not seen since the peak of South African AIDS denialism in the early 2000s (Simelela *et al.*, 2015), acceptance of evidence for or against HCQ split down partisan lines in the USA. A major global study in the prestigious medical journal *The Lancet* reported that HCQ showed no benefits in COVID-19 and provided evidence of elevated cardiovascular adverse events and decreased survival in patients receiving the drug (Mehra *et al.*, 2020b). The HCQ arms of several major international trials were immediately suspended, and several nations advised against using the drug for COVID-19. Yet little more than week later, the study's authors retracted it in full (Mehra *et al.*, 2020c) – along with a parallel study on cardiovascular risk in COVID-19 patients, published in the *New England Journal of Medicine* (Mehra *et al.*, 2020a) – after it emerged that the commercial dataset that they had used was at best unvalidated, if not actually fraudulent. Their papers had been accepted for publication after peer review in two of the world's most prestigious medical journals. Studies including HCQ restarted, then closed down again (WHO, 2020c). At the time of writing, most jurisdictions now advise against the drug's use in COVID-19 patients. This is not the place to second-guess what the eventual verdict of large-scale trials will ultimately be on HCQ's true efficacy in different patient cohorts. However, its story so far is a cautionary tale on the perils of attempting to base agile policy and clinical decisions on fast-moving and contradictory, partial evidence – especially once denialist claims take a hold in political networks; and it provides an extraordinary illustration that scientific error and misconduct can occur even in the midst of the response to a global public health emergency.

4. The COVID-19 pandemic in a damaged information ecology

Health and medical research have long relied on the publication of results in peer-reviewed scientific journals as the key mechanism for quality control and dissemination. The wisdom of this reliance has been under question for several years in the light of the emerging 'crisis of reproducibility' affecting medicine and many other scientific disciplines (Ioannidis, 2005, 2016; Munafò *et al.*, 2017). Attempts to massively accelerate the generation and publishing of COVID-19 research as an urgent response to the voracious hunger for information on the pandemic were therefore always going to contain some inherent risks to quality and reliability, even though emerging alternatives (such as the increasingly popular use of online preprints) still offer no real substitute for the peer-review process. Journals across healthcare and beyond issued special calls for papers and instigated accelerated review processes for COVID-19 submissions. By early July, more than 30,000 articles on COVID-19 were listed on the health bibliographic database PubMed (Saitz & Schwitzer, 2020). From a first submission on COVID-19 on 15 January, the journal *Lancet Global Health* saw its total submissions increase by 185% by June 2020 relative to the previous year (*Lancet Global Health*, 2020). Unsurprisingly, many journals have experienced a degree of overwhelm in this period, amongst editors, reviewers and, indeed, readers. Yet pharmaceutical and vaccine companies have drawn criticism for a tendency to release favourable results by press release, rather than via scientific publishing routes – a critique that has also been levelled at the UK's nationwide, publicly funded RECOVERY trial, which has thus far led the way in delivering large-scale drug trial results on COVID-19 therapies (Wise & Coombes, 2020). Box 1 describes how some of the limitations of the current peer-reviewed publication model for dissemination have manifested themselves in the particularly controversial case of the drug hydroxychloroquine.

However, there have been even more worrying signs of a fracturing information ecology at the interface of science, policy and public discourse. Contested scientific evidence around interventions such as hydroxychloroquine and the use of facemasks by the public has somehow mutated into their becoming political totems in a number of countries. The undermining of WHO by the US government's decision to withdraw from membership, after months of criticism, has interacted with the perceived failure of many national institutions, most notably the US Centers for Disease Control and Prevention, leaving a void in authoritative guidance that has allowed vested interests and conspiracy theories to gain a foothold. Growing 'vaccine hesitancy' and the rise of the 'antivaxxer' movement have been evident for several years (Dubé *et al.*, 2015), with WHO listing this phenomenon only last year

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(along with a global pandemic and the emergence of high-threat pathogens) as one of its top ten threats to global health (WHO, 2019b). COVID-19 has given further life to antivaxxer narratives and conspiracy theories, with recent polls indicating that 30–35% of young American adults probably or definitely would not accept a COVID-19 vaccine (AP-NORC, 2020). More broadly, the emergence of COVID-19 in the hyper-connected social media world of 2020 has given rise to grave problems of misinformation on many aspects of the pandemic (Santos-Rutschman, 2020) and concerns that some of these trends may in fact reflect deliberate disinformation strategies by state and non-state actors in the new era of 'information warfare' (Prier, 2017).

5. Lessons for global sustainability

The damaged information ecology in which global and national responses to COVID-19 are currently playing out should be of deep concern to all those working towards the adoption of more sustainable policies, economics and ways of life. There have been significant failures of global information coordination and cooperation just when the stakes were highest; international and national institutions have struggled to retain authority and confidence in the face of a flood of misinformation and the appropriation of the pandemic for political purposes in several nations. The worst excesses of COVID-19 politicization and denial bear many resemblances to battles that have played out over climate change science and policy for decades. It is chastening to see similar forces also infect a global public health emergency. COVID-19 is not a dress rehearsal for dealing with climate change and planetary boundaries. Yet it may be closer to a dress rehearsal for dealing with the cascading crises that ecological tipping points will bring with them; and if it is, the results do not look pretty so far. We need to ensure urgently that the science–policy nexus is stronger and more robust to uncertainty and disinformation at national and international levels, not only to support long-term policymaking, but also to avoid chaotic responses to more immediate crises.

More broadly, we need modes of knowledge generation and innovation that prioritize human welfare over profits. Financial prizes or governmental purchase of patents (Baker *et al.*, 2017) can make knowledge free, but fail to stimulate cooperation in research and development (R&D). The peer-to-peer (P2P) and commons knowledge economy prioritizes the sharing of information and knowledge. P2P and open hardware make designs and knowledge freely available through open licenses, incentivizing competitive firms to produce them at the lowest possible cost. P2P builds on humanity's altruistic and cooperative nature as a mode of relationship that allows individuals to connect, collaborate, produce and share without barrier or gain beyond collective pro-social evolution (Pazaitis *et al.*, 2019), but it could be made even more effective with public financing, especially for R&D into urgently needed public goods. Land-grant universities in the USA once took this approach, until the Bayh–Dole Act of 1980 allowed both industries and universities to exclusively patent publicly funded innovations (Sampat, 2006). Salaried scientists are unlikely to work harder for corporate profits than for the public good, and free knowledge still exploits the ability of competitive markets to minimize production costs. There is increasing acceptance among economists that the state must do much more than simply attempting to fix market failures and that transitioning to a sustainable economic model requires active steering by the state to create a technological revolution for the benefit of all (Mazzucato, 2016; Perez, 2017). Our response to global pandemics and other contagious diseases requires a commons knowledge economy, in which P2P-generated and publicly funded R&D into treatments and cures is freely available to all. Even before COVID-19, the effective abandonment of new antibiotic development by the for-profit pharmaceutical industry (WHO, 2019a) – desperately needed in the face of the rising tide of antimicrobial resistance – should be a warning signal that traditional models of for-profit innovation may fail when faced with such complex challenges.

While many people claim that the COVID-19 pandemic illustrates the need for a more resilient economy, we may well have passed so many ecological and economic thresholds that bouncing back is not only undesirable, but also impossible. The most pressing challenges society currently faces, from climate change to pandemics, are social dilemmas best solved through cooperation (Gintis, 2011). While competition for fossil fuels is unavoidable, there is no competition between geographical regions for the solar energy that must replace it, and the knowledge for capturing it improves through use. Patents on green technologies also create artificial scarcity, hindering our fight against ecological calamity. Cooperation is an anti-fragile strategy (Taleb, 2012) in which each challenge we collectively confront stimulates the trust and reciprocity required to address more difficult future challenges. Cooperative generation and sharing of knowledge, stimulated by playful curiosity, trust and reciprocity, will not only help us to solve the COVID-19 crisis, but also enhance our ability to solve the numerous other crises we currently face.

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