

How to Publish at Pandemic Speed

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As SARS-CoV-2 spread across the world, many researchers sought to contribute to reducing its impacts by rapidly pivoting from their primary research to study COVID-19. Thousands of papers resulted from this wartime-like effort. One estimate suggests that 1 in 20 papers published in 2020 was related to COVID-19 (Else 2020). These articles guided—and continue to guide—policies, interventions, treatments, and our understanding of the pandemic's broader societal impacts at previously unimaginable speeds. But the speed of publication could not keep pace with the speed of research—or of the rapidly spreading pandemic.

As the crisis grew, journals did their best to meet this unexpected surge. Many prioritized the review and publication of COVID-19 research and expanded their pool of reviewers while editors and reviewers worked tirelessly to vet submissions (Eisen et al. 2020, Horbach 2020, Kwon 2020). Publication speeds accelerated, often taking a fraction of the time for a process that often takes a year (Björk and Solomon 2013). In one analysis, virology journals halved the time to publish COVID-19-related articles from 117 to 60 days (Horbach 2020). In addition, many journals introduced generous policies that allowed authors to upload preprints to servers and made COVID-19 research open access. Publishers, editors, and reviewers did their best with the standard model of scientific review and publishing during these historic times.

A system overloaded

However, the scientific review and publication pipeline was never

intended to handle so many articles at such great speeds and with such immediate implications for public health. Just as research publication rates began to rise, illness, stress, and new demands (e.g., home schooling) decreased reviewer availability and slowed down their reviewing (Else 2020). Homebound scientists not only contributed COVID-19 research but also churned out more submissions on all subjects (Else 2020, <https://doi.org/10.1101/2021.01.21.427563> [preprint: not peer reviewed]). This surge in publications created a perfect storm for publishing, and the scientific review and publication system lagged behind (figure 1). This bottleneck in the process created two problems.

First, many authors uploaded drafts to non-peer-reviewed preprint servers before publication to ensure that important results were made public quickly. Policymakers and the media were left to sift through these preprints and arbitrate which scientific results to disseminate and promote rather than relying on the normally robust system of peer review. Erroneous and potentially dangerous research was posted to preprint servers and promulgated by the media, resulting in many preprint papers being retracted (Kwon 2020, <https://retractionwatch.com/retracted-coronavirus-covid-19-papers/>). One paper suggested a home remedy for COVID-19, another falsely suggested its similarity to HIV, and one incorrectly alleged an origin in India. This problem became so acute that the preprint servers themselves began to reject papers with unsubstantiated claims (Kwon 2020). We see no fault with the preprint

servers. They carried out their purpose and provided a medium for the rapid dissemination of COVID-19 research. However, preprint servers were not created to provide the traditional peer review that is the gold standard of scientific publishing.

Second, by the time many submissions were published, their results often had become too outdated to inform policies and save lives. We, too, switched to modeling COVID-19 seasonality, and after 34 days, submitted a paper to medRxiv in record time. We submitted this preprint for journal review on 1 May, and it was published 166 days later, on 13 October (Merow and Urban 2020). This period was blazingly fast for science but an agonizingly long wait for the publication of our predictions about a second wave of COVID-19 starting in September. Our preprint was available before publication and, indeed, was reported by the media. However, without the gauntlet of peer review, it was rightfully treated with skepticism. The publication times for many other articles were quicker than our anecdotal experience: 63 days on average from preprint to publication in one study (<https://doi.org/10.1101/2021.01.21.427563> [preprint: not peer reviewed]). However, the fact remains that the overall system was not suited to performing at pandemic speeds. Importantly, we do not suggest a weakening of review standards. We fully support peer review and the need for multiple revisions, *especially* during a crisis, when accurate science is needed more than ever. We just need to do it faster.

Be assured that we are not criticizing editors or reviewers; they complete

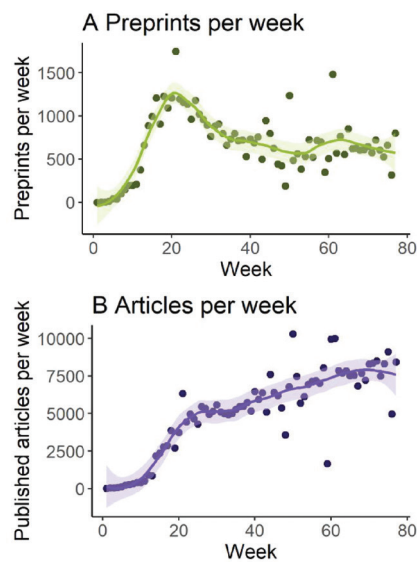


Figure 1. (A) Preprints and (B) articles on COVID-19 per week between 30 December 2020 and 14 June 2021. The fit is loess, with a span of .35, and the error bars represent the 95% confidence intervals. Preprints peaked in mid-May, but published articles have yet to peak. Note the difference in scales. Source: <https://reports.dimensions.ai/covid-19>.

their tasks thanklessly, often without pay and despite full workloads. However, something is wrong when journalists, not scientists, vet science and when critical information becomes obsolete before publication.

A more strategic approach

Although the pandemic is still not over and new surprises await scientific exploration, we should begin to learn from this crisis and prepare for the next one. Crises are likely to increase in frequency in the coming years, requiring more rapid cycles of scientific and technological innovation to solve them (Bettencourt et al. 2007). Emerging infectious diseases are predicted to become more common as human populations grow denser, wildlands are degraded and converted to agriculture, human–wildlife contacts expand, and climate change disrupts disease dynamics (Easterling

et al. 2000, AghaKouchak et al. 2020). Moreover, the accelerating impacts of climate change could augur a series of novel disasters that require immediate scientific input (Easterling et al. 2000, AghaKouchak et al. 2020).

To meet these future challenges, we need strategies that both strengthen peer review and radically decrease review times. Therefore, we advocate for the formation of rapid-review boards and scheduled reviews.

Rapid review boards would include editors and subject matter experts that agree to be on call to provide rapid assessments (in days, not weeks) during future crises. For example, the *Royal Society Open Science* journal created a rapid review board for submissions of preregistered protocols for COVID-19 research. Over 700 researchers agreed to review the preregistered protocols within 48 hours of receiving them (Brock 2020). The MIT Press set up a rapid-review panel for preprints identified to be of particular relevance (<https://rapidreviews-covid19.mitpress.mit.edu>). However, we do not know of an instance of a traditional journal that created a rapid review board to handle the onslaught of COVID-19 research.

Building from these designs, we call on journals to create strategic plans for forming rapid review boards for this crisis and the next one. Such boards would not need to be convened until a crisis begins, but at that point, they can be quickly activated. Scientific academies, societies, and nonprofit organizations already form expert boards for other issues. For example, the US National Academies assembled a board of their experts to weigh in on preliminary evidence about the factors related to the pandemic (National Academies of Sciences, Engineering, and Medicine 2020). Many experts would volunteer for these prestigious rapid-review board positions out of goodwill, but journals might also establish a system whereby submission to the rapid review system also requires that the authors agree to complete some number of future rapid reviews. The

system could be a triple win: Relevant science would be published quickly, scientists would receive rapid reviews on their submissions, and the journals employing rapid review would benefit by receiving a disproportionate share of the high-impact and relevant manuscripts.

Activating rapid review boards should not be done lightly, and not every catastrophe is likely to generate a surge of publications that require rapid consideration. We suggest that publication times will become critical through some combination of novelty (N), impact (I), and the time sensitivity (T) of scientific conclusions (need $\approx N \times I \times T$). COVID-19 was a novel disease, had global impacts, and was extremely dangerous, and the science needed to make decisions about interventions and treatments was needed immediately. Therefore, it measures high on this $N \times I \times T$ scale. In contrast, an outbreak of an existing disease is unlikely to precipitate the same need because novelty is low.

Complementary to this approach would be to create a system of scheduled reviews that includes presubmission screening and scheduling. Not all submissions require rapid reviews; therefore, authors should apply for rapid review by making the case for the timeliness of their publication and submitting an abstract. For example, COVID-19 papers about life-saving treatments would be prioritized over those with less immediate health impacts. Second, once an article is accepted into the rapid review system, the editor could work with the authors to schedule a submission date. The editor could then notify the rapid review board members to ensure they are available and willing to review the paper right after submission. This practice would cut the time required to solicit reviewers after a paper has been submitted and would also allow the reviewer to plan their schedule accordingly in order to ensure rapid review completion.

Whatever process is implemented, it should be continually assessed and revised to ensure not only rapid

reviews but also accurate, complete, and fair reviews. Many peer-reviewed articles were eventually retracted or even misled pandemic responses, including one that cast doubt on early SARS-CoV-2 test kits that led the United States to develop their own faulty version at a critical point of the pandemic (Marcus and Oransky 2020). Ensuring the same standard of review—but faster—will be a challenge but not an insurmountable one. In our experience, most reviewers take no more than a day or two to complete a normal review, but they often do not start until the end of the review period. Reviewers informed about or incentivized to submit reviews faster would hopefully perform their review to the same high standards but much sooner. At the same time, reviews should not be rushed once they have begun; editors should allow more reviewing time for research that is particularly challenging or consequential in its impacts. We call for reviews that are well-timed and scheduled but not slapdash or careless. Finally, it will be critical to identify and eliminate fiduciary or other barriers that prevent submissions by underrepresented groups or developing countries. This practice will be especially important in order to empower scientists working in susceptible communities and high-risk regions.

Conclusions

Creating policies that can ensure rapid, robust, and fair reviews now and before the next crisis will ensure that science can remain relevant to

the societies that it serves. Rapid review boards, scheduled reviews, and early online publication provide a series of critical steps toward solving this problem. During this or any crisis, we need the best science written, reviewed, and given the imprimatur of publication at lightning speeds. We need a process to ensure quick review and publication now and before the next crisis strikes.

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