

All that's fit to preprint

COVID-19 has reinforced the importance of preprints as an indispensable means for rapid research dissemination.

The uptake of preprints during the COVID-19 pandemic has been nothing short of remarkable. In April, the clinical preprint repository [medRxiv](#) published between 50 and 100 SARS-CoV-2-related posts daily. The burgeoning adoption of preprints by the medical community in recent months underscores their importance as a means for rapid sharing and updating of research findings during an outbreak. In the longer term, it also may prove a watershed moment, signaling the arrival of preprints as a legitimate complement to peer-reviewed journals, broadening their acceptance among a wider community of researchers, and accelerating their integration into journal publishing workflows.

Preprints — unvetted versions of research papers — offer open publication, establish precedence of research, enable rapid dissemination of results, provide early recognition and visibility for work (especially for early-career researchers) and avoid the selection bias against negative findings commonly associated with traditional peer review. Although they are not a new idea, they only took off in the life sciences after the 2013 launch of [bioRxiv](#); today, at least [44 different archives](#) host biology preprints; most are non-profit, community-based repositories, although traditional publishers, such as Elsevier (SSSN), are also getting into the game.

Against this backdrop, the medical community has remained relatively unengaged. This changed last June, when *BMJ*, Yale and Cold Spring Harbor Laboratory [launched medRxiv](#), a preprint server entirely dedicated to clinical research. At first, uptake was slow, but when SARS-CoV-2 emerged, medRxiv took off.

As *Nature Biotechnology* went to press, the repository had received over 1,941 COVID-19 preprints, ranging from clinical trials of therapeutics to diagnostic tests, personal protective equipment, and epidemiology or modeling, and bioRxiv had posted 508 SARS-CoV-2-related preprints. Over the same period, 7,136 COVID-19-related papers appeared in PubMed. This last statistic is notable because the number of COVID-19 preprints (2,449) as a proportion of peer-reviewed papers (7,136) published since the beginning of the year is high (34%). In comparison, preprints from these archives represented only 2.2% of

papers indexed in PubMed last year (30,627 preprints versus 1,401,413 papers). Thus, preprints represent a larger proportion of SARS-CoV-2-related research than is typical for other research.

The pandemic has also changed the ways preprints are viewed after, and screened before, posting. At medRxiv, all preprints carry a disclaimer indicating that they have “not been certified by peer review” and “should *not* be used to guide clinical practice.” Submissions also have to pass two types of prescreening: first, a set of clerical checks for author consent, plagiarism, clinical trial registration and ethics compliance (institutional review board approvals and privacy protections), along with declarations of competing interests, funding sources, and data and code availability; and second, a check by affiliated experts to determine whether a post is spam, nonsense or pseudoscience, is dual-use research, or has the potential to cause harm by changing public behavior (for example, a claim cigarettes don't cause cancer or vaccines cause autism). Because of potential concerns over self-medication or runs on over-the-counter drugs during COVID-19, medRxiv and bioRxiv now no longer post *in silico* predictions of drug efficacy without additional biological evidence.

Improvements are also being made to preprint evaluation after posting. Although some servers have moderated comments, only a small proportion of preprints attract feedback. One [recent development](#) has been for journals to post referee reports on the preprint version of a paper under review. A grassroots initiative, [PREreview](#), aims to facilitate constructive feedback, educate a broader global community of reviewers, and convene virtual journal clubs on preprints. To review a preprint, users require an [ORCID](#) account and must agree to a [code of conduct](#); users posting preprints can also request feedback from the PREreview community. In January, PREreview partnered with non-profit Outbreak Science on a version for epidemics, which has already accrued 360 users, 60 rapid reviews and 163 requests for reviews.

Providing community feedback and context on preprints is [critical](#), especially at a time when so many eyeballs are on COVID-19-related content. The potential harm from posting erroneous provisional research is

one reason why the medical community was so cautious about preprints in the first place.

A case in point is bioRxiv's most downloaded [preprint](#), which some interpreted as suggesting that SARS-CoV-2 was lab-created on the basis of its “uncanny” similarities to HIV. After Twitter lit up with conspiracy theories, numerous comments were added within hours of posting, leading the authors to withdraw the preprint two days later. Although correction was certainly faster than is typical at peer-reviewed journals, by then the damage had been done. Similarly, preliminary findings on bioRxiv have [wiped millions](#) off biotech company market capitalizations — although, to be fair, [erroneous peer-reviewed papers](#) have had similar [negative impacts](#).

Before COVID-19, recognition of preprints as a means to make research available as quickly and widely as possible was already growing. Funders like the US National Institutes of Health [encourage](#), and the [Chan Zuckerberg Initiative](#), [Aligning Science Across Parkinson's](#) and the [Michael J. Fox Foundation](#) mandate, their use. Scholarly communication services such as [CrossRef](#) and [ORCID](#) have integrated them.

Publishers are also taking notice: Wiley and Springer Nature offer to post a submission as a preprint together with transparent peer review for some journals via [Authorea](#) and [In Review](#), respectively. So far 173 journals allow submissions of preprints [directly transferred](#) from bioRxiv, and [over 30 journals](#) offer opt-in posting of preprints on bioRxiv after submission. All of which adds up to more and more researchers becoming convinced of preprint legitimacy (and worrying less about being scooped).

What emerges is an interconnected publishing ecosystem where preprints are bidirectionally linked to peer-reviewed papers, which in turn are bidirectionally linked to postpublication comments, updates and amendments. Scientific communication will move from isolated research snapshots to living time-stamped documents with perpetual vetting by a broader base of researchers. That sounds like a better publishing system than the current one — not only for outbreaks, but also for science as a whole. □

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