Ten Simple Rules for Post-pandemic Preprinting

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Preprints are research articles shared in the public domain before formal publication in an academic journal. They are housed in online repositories known as preprint servers, the largest and most well-established of which include arXiv (physical sciences), bioRxiv (biological sciences), SSRN (social sciences), and Research Square (multidisciplinary). In early 2020, preprint servers had to adjust to huge volumes of pandemic-related research submissions. Many preprint services adjusted their approach to screening and imposed new restrictions on the type of content they would agree to post. Some preprints became the focus of intense public scrutiny and were rapidly withdrawn. Some were misunderstood and exploited in the service of disinformation campaigns. The following is a list of ten simple rules for preparing a preprint submission, incorporating our learnings from more than 20 months of navigating rapid research dissemination in a global pandemic.

1 Place your best foot forward

One appeal of preprint servers is that they have few, if any, requirements for formatting and image quality. This, coupled with the lack of copyediting or typesetting, means preprints often have a "draft" feel. That said, any version shared with the world should be ready for scrutiny and evaluation. This means the figures and tables presented in the preprint must be clear and accurate, their in-text citations must be correct and consistent, and the visuals should support the conclusions. All scholarly manuscripts stand to benefit from a close reading by one or two trusted colleagues before they are submitted anywhere. Errors and poor writing may not stop a preprint from getting posted, but an author's focus should be on the reception that the preprint will get from the scientific community.

2 Always tell a complete story

During the pandemic, preprint servers became popular venues for short-form findings. But even if very short, a preprint should be a complete story that includes coherent objectives, descriptive methods, and a discussion that meaningfully follows from the results. A preprint should be a full article that could reasonably be considered by a journal, regardless of the author's intent to publish in one. Many preprint servers limit their content to only experimental research, but some will accept more narrative contributions like commentaries and non-systematic literature reviews.

3 Check your stats, and interpret with care

As with any contribution to the literature, it's critical that the statistical methods used in an analysis make sense and are consistent with the research aims and results presented. Moreover, the interpretation of the results should be supported by the results themselves, and authors should take care not to exaggerate their findings. Because preprint submissions generally have not received peer review feedback, there is an expectation that they are more likely to contain common errors. But this should not make authors complacent. They should instead take extra care to avoid basic errors by reproducing the analysis and asking colleagues with statistical expertise to check their work before submitting.

4 Invite peer and community review

A preprint is an invitation for feedback from the entire scientific community. Authors can gain feedback by directly inviting reviewers or by "sharing" the preprint on social media. Community feedback may be as useful as peer review and can catch both minor and major errors that "formal" reviewers may not notice. A diverse set of initiatives have emerged to facilitate peer review on preprints, providing both structure and moderation to the review process. Some prominent examples are Review Commons, PREreview, and Peer Community In. After review, a revised version of the preprint reflecting reviewer feedback should be uploaded to the preprint server so that references to the work point to the most current version available.

5 Link to your study protocol/preregistration

A study protocol, or a pre-registration, is an instruction manual written prior to conducting the study. These reduce bias by outlining in advance the study's objectives and methods, which can then be assessed after full publication of the completed study. If the objectives and methods/analyses are different, it might indicate "selective reporting bias", or selection of only analyses or outcomes that are statistically significant. A preprint study protocol can be registered on a site like Protocol Exchange or OSF, allowing authors to mitigate potential bias through transparency of methods. Transparent and complete reporting is a principle of the Open Science movement, and methodological transparency is especially important for preprints, which lack the traditional evaluation mechanisms that may confer such credibility.

6 State your purpose, and say it plainly

Clearly stating objectives, avoiding jargon, and minimizing abbreviations are underrated best practices for effective research communication. A study's aims drive the methods that dictate its conduct, so the rationale for the study should be clearly written and argued. Authors should also strongly consider including a plain-language summary or graphical abstract with their preprint. COVID-19 preprints have garnered significant attention from people seeking new information on SARS-COV-2 epidemiology, pathology, and immunology, all of which can be daunting topics for non-experts. But the ambiguity and abstruseness of jargon-filled scientific articles has been repeatedly exploited by people seeking to warp the information landscape around the most controversial topics. A lay summary can safeguard against this disinformation.

7 There is no such thing as a negative result

Studies do not have positive or negative results. They just have results. The so-called "file drawer" effect, whereby null results are hidden away rather than reported, has notoriously resulted in the selective reporting of "positive" results, creating a body of literature that poorly represents the totality of experimental results. Preprint servers do not make acceptance decisions based on study results and therefore offer an excellent venue to make public any results that may struggle initially to find a home in more traditional journals. During the pandemic, fast reporting on the numerous failures of certain treatment and prevention approaches was just as important as reports on successful regimens. Compiling evidence on treatment failure helps ensure that practitioners minimize the exposure of patients to ineffective or potentially harmful treatments.

8 Share your data

The thrum of calls to improve the culture of data sharing in the research community reached a fever pitch in the months after March 2020. Many researchers who never preprinted before quickly seized the opportunity to share new data about the virus. While sharing data via preprints offers no guarantee that the work was carried out in a rigorous or methodologically appropriate way, it does provide a signal that the author is open to having the data scrutinized and reanalyzed. Research without its underlying data is simply not reproducible. This can become a serious issue when a study claims to have discovered an effective prophylactic or treatment in the context of a clinical trial for which individual patient-level data have not been made readily accessible.

9 Declare your funding sources and competing interests

Science, at its best, is the pursuit of knowledge, unencumbered by confirmation bias and uninfluenced by secondary interests. Unfortunately, researchers can be influenced by financial or ideological incentives to present data selectively, p-hack, or commit other types of research misconduct. Some have argued that preprint servers, with their low entry barriers, select for these types of behaviors. While this question has not been studied explicitly, it is true that not all servers specifically require declarations of funding or conflicts of interest for all types of submission. Therefore, it is critical that preprint authors take responsibility for ensuring these statements are thoroughly transparent and included in their preprint submissions.

10 Link your preprint to the published paper

Most preprints (around 65%) eventually get published in a peer-reviewed journal, and this version is typically the one that authors prefer people to reference for citations. For this reason, it's important that authors verify their preprint is visibly linked to this version of record. Linking also helps ensure that important information that may be generated downstream – such as corrections, errata, or retractions – can be back-propagated to the preprint. Only a few preprint platforms automatically link published papers to their corresponding preprints shortly after publication. Authors can also include a note in their published manuscript referencing the preprint.

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