

Forecasting the Growth of Preprints in Biology

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Preprints, or complete scientific manuscripts posted online before journal-organized peer review, have been common in subfields of biology for a long time: the quantitative biology section of arXiv.org has been steadily growing for more than a decade. But since the emergence of new services that specifically cater to the life-sciences community (notably PeerJ Preprints and especially BioRxiv), the growth in new preprints posted per month has been marked (Figure 1).

Still, 900 preprints posted per month represent just 1% of the approximately 100,000 articles that appear in PubMed during the same time frame. So, does this recent growth represent a bubble, or is this the start of new way for biologists to communicate? The answer will depend on four factors.

1. Cultural change

In early 2016, Ron Vale, Harold Varmus, Daniel Colón-Ramos, and I organized a meeting at the Howard Hughes Medical Institute (HHMI) to discuss the role preprints could play in accelerating communication in the life sciences.¹ Called ASAPbio, the conference brought together junior and senior scientists, publishers, funders, and other stakeholders for a day and a half of discussion. Toward the end of the meeting, we asked attendees to state whether they would, in theory, support statements about the use of preprints. We were surprised to find the responses were overwhelmingly positive.²

Given the readiness to consider new ways of communicating scientific information we saw at this meeting, we decided to move forward to actively promote the productive use of preprints in the life sciences. We do this by convening stakeholders (funders,³ technological experts,⁴ and scientific societies⁵), providing information resources for scientists and others, monitoring policy changes, and enabling discussion online and in the real world.

This latter activity is particularly important: cultural change depends on more than just awareness and incentives. It occurs when individuals see a behavior practiced by their peers. In this case, that means colleagues in their labs,

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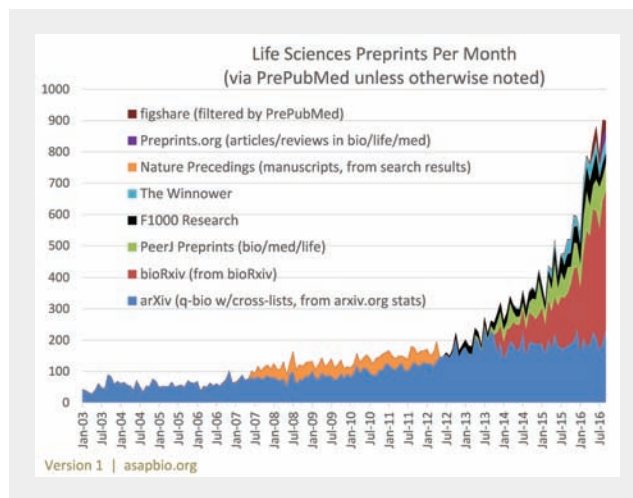


Figure 1. Life sciences preprints per month (via PubMed unless otherwise noted).

departments, and scientific societies not only posting but also talking about their preprints.

Cultural change also will emerge as preprints become incorporated into the educational pathway. For example, preprint journal clubs give students the opportunity to make constructive critiques that can help improve early versions of a manuscript, a process that is satisfying for both participants and authors.⁶

2. Preprint policies

Of all the groups represented at the first ASAPbio meeting at HHMI last February, the funders were arguably the most progressive. Preprints can offer a more up-to-date way to show reviewers an applicant's productivity, and they can also make the results of a funded research project publicly available as soon as possible. During the time a paper might otherwise be undergoing peer review, preprints give funding agencies more information to assess their grant-making strategy.

In January of 2017 alone, three major funding agencies (the Wellcome Trust, Medical Research Council, and HHMI) announced new policies that will allow researchers to cite their own preprints as evidence of productivity in grant applications or reports.⁷ HHMI has gone a step further: in 2018, it will not consider papers listed as "submitted"; these must instead be released as preprints to be considered as

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part of a review. Late last year, the National Institutes of Health also released a request for information to collect feedback about the use of preprints in grant applications and reports, which contained a list of standards that preprints would have to meet in order to be citable (such as preservation, attribution, links to other versions, etc.).

Funders are not the only institutions seeing the value of preprints. The Rockefeller University and the University of California, Santa Cruz, have both specified that preprints are welcome on applications to their tenure-track faculty positions. The New York University School of Medicine has changed the list of materials accepted for appointment, promotion, and tenure to include preprints.⁸

With concrete incentives—namely, the chance to accurately demonstrate productivity to earn a grant or land a job—researchers who are curious but hesitant about posting preprints will likely take the leap.

3. New players and infrastructure

Since the ASAPbio meeting, several other organizations have launched preprint services, including the Center for Open Science and preprints.org. The American Chemical Society has announced it will launch ChemRxiv. Public Library of Science (PLOS) has a stated interest in “ahead-of-publication posting.”⁹ Scientific societies and large-volume publishers stand to make major contributions to the number of preprints posted by giving authors the option to post their manuscripts to a preprint server at the time of journal submission.

The emergence of more preprint servers is great for innovation but potentially problematic for researchers looking for a comprehensive source of preprints. Furthermore, licensing, preservation, and screening standards are different across the existing preprint servers, inhibiting the development of uniform expectations for what preprints can contain and how they will change over time. Finally, it’s becoming increasingly difficult to access all preprints for text and data mining—and most sources provide no programmatic way to access the content anyway. For these reasons, ASAPbio is planning to launch a “Central Service” to aggregate, preserve, and facilitate access to life-sciences preprints.¹⁰

4. Preprints and scholarly journals

The trend in preprint growth prompts an important question: in an imaginary future when 90%, rather than 1%, of biology papers are first released as preprints, what role will journals play?

If biology is anything like physics, their role will be just as significant as it is now: 73% of older preprints on arXiv can be matched to a journal article on Web of Science.¹¹ The reason for this is simple: journal publication is crucial

for validating the work and signaling its value to those outside the authors’ immediate field. The internet makes the process of disseminating research results easy, cheap, and fast, but journals need not see this as encroachment of their territory. Rather, journals offer services that are infinitely more valuable and essential: the evaluation, curation, and organization of peer review.

Ron Vale, Tony Hyman,¹² and Jan Velterop¹³ have argued that separating the process of knowledge disclosure from evaluation is beneficial for authors. Going a step further, Bernd Pulverer pointed out that this decoupling may actually relieve the pressure on journals to conduct peer review as quickly as possible.¹⁴ With preprints, the quality of the peer review, rather than its speed, can be prioritized.

Most major journals in the life sciences will consider publishing manuscripts that have previously appeared as preprints.¹⁵ Medical journals have historically been more conservative in following the Ingelfinger rule. However, the culture is changing: in December 2016, the International Committee of Medical Journal Editors modified its recommendations to indicate that preprints need not constitute prior publication.¹⁶

Some journals have not only changed their policies to allow preprint posting but have gone further to enact editorial practices that take advantage of the system.¹⁷ For example, many biologists report being approached by editors inviting submission of their preprints. *PLoS Genetics* has formalized this process by creating “Preprint Editors”—three individuals whose job is specifically to invite submissions from preprint servers. These policies effectively turn preprint servers into a marketplace where authors and editors can more effectively match their papers to appropriate journals.

These developments are heartening signs that many stakeholders see the benefits of preprints and are ready to work together to accelerate scientific communication and the process of discovery. Funders, scientists, and especially journal editors will continue to play vital roles in defining a communication system that embraces both modern technology and the human need for curation—and in bringing this system to life.

Links and References

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