MEDICINE AND SOCIETY

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No Free Lunch — What Price Plan S for Scientific Publishing?

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What would you do if you thought that something — say, a specific business model — stood in the way of scientific progress, and you had created an alternative model that you believed would be both less expensive and more beneficial for the advancement of science and society? You would probably test your new model to see if it worked. Open access publishing was such a new, aspirational idea in 2001.

"An old tradition and a new technology have converged to make possible an unprecedented public good. The old tradition is the willingness of scientists and scholars to publish the fruits of their research in scholarly journals without payment, for the sake of inquiry and knowledge. The new technology is the internet." Thus begins the Budapest Open Access Initiative (BOAI) mission statement,[1] published by a small group of dedicated people who gathered in George Soros's home town in Hungary in December 2001, with funding from his philanthropic Open Society Foundations, for a meeting now recognized as one of the major defining events of the open access movement. The BOAI was followed in 2003 by the Bethesda Statement[2] and the Berlin Declaration[3] on open access.

It is easy to agree in principle on the advantages that the Internet could offer to science. As the BOAI explained, "The public good . . . is the worldwide electronic distribution of the peer-reviewed journal literature and completely free and unrestricted access to it by all scientists, scholars, teachers, students, and other curious minds. Removing access barriers to this literature will accelerate research, enrich education, share the learning of the rich with the poor and the poor with the rich, make this literature as useful as it can be, and lay the foundation for uniting humanity in a common intellectual conversation and quest for knowledge."[1]

The idea — that the results of research should be available to be read, discuss, and examine, so that flawed results can be rejected and new scientific discoveries be made on the basis of sound evidence — has few, if any, opponents in either the scientific community or the public. Nor is there any disagreement over the fact that the Internet has profoundly and permanently changed the ways in which information can be disseminated and discussed and has therefore changed scientific publishing considerably. All forms of publications are more publicly accessible today than they were 20 years ago.

But the open access movement developed not only because of the new opportunities provided by the Internet for dissemination of science, but also because of frustration over rising subscription costs — and profit margins — of traditional journals and publishing houses. Librarians felt caught in a bind because researchers who had published in journals, peer reviewed for them, and maybe even served on their editorial boards naturally wanted access to those journals in their institutional libraries. When subscription costs became too high, the blame was placed on the traditional business model of scientific publishing, which was seen as restricting access to science. New business models in which authors or funders paid for publication instead of readers or institutions paying subscription fees, and in which there was an open approach to copyright so that both reading and unrestricted reuse of the content were free, were necessary for the advancement of science. This model — now called "Gold Open Access" — would also drive costs down: "The significantly lower overall cost of dissemination

is a reason to be confident that the goal is attainable and not merely preferable or utopian."[1]

TESTING THE HYPOTHESIS

So went the hypothesis. Now, 17 years after the BOAI, where do we stand? Has the open access publication model created "an unprecedented public good"? Has it accelerated research and advanced science, as Peter Suber, director of the Harvard Open Access Project, claimed on the occasion of the 10th anniversary of BOAI, writing that "Barrier-free access helps readers find and retrieve the research they need, and helps authors reach readers who can apply, cite and build on their work"?[4] And have costs come down?

To answer the last question first: if anything, the total cost of publishing is actually increasing. The five largest publishing houses (SAGE, Elsevier, Springer Nature, Wiley-Blackwell, and Taylor & Francis) continue to grow, with high profit margins. Open access publishing is also growing, which means that in addition to subscription fees, researchers and institutions are paying fees to get their research published. Growth in the overall cost of publishing was predictable, because even if online dissemination is less expensive than printing on paper and distributing by mail, the Internet has also opened up new ways of presenting content and interacting with researchers and readers that add value but cost money. Most important, the cost of producing high-quality content is independent of the dissemination method used. Electronic production and maintenance of high-quality content are at least as expensive as print production and maintenance. For example, with electronic publications, we have come to expect more dynamic papers with clickable references, active links to related articles, and supplemental information — all of which need to be maintained and kept current on the journal's website and servers. Electronic editorial systems have many advantages, but they have also created more work checking the originality and validity of submissions: it has become easier to manipulate images and to plagiarize. Even authors' and reviewers' identities may have to be double-checked.

Whether an open access publication model is accelerating research and advancing science is more difficult to determine. Both researchers and the public prefer open and accessible sources. Researchers have examined whether there is a "citation advantage" of open access publishing — whether researchers' work is cited more if they publish in an open access journal rather than a subscription journal. The Scholarly Publishing and Academic Resources Coalition (SPARC) Europe compiled a list of 70 studies exploring this question that were published between 2001 and 2015 and found some advantage for open access in a majority of the studies.[5] A 2016 study by Tennant et al. found a citation advantage in some fields, although the magnitude of the effect was highly variable.[6]

The citation advantage is also exactly what the journal impact factor measures. There are many things the impact factor doesn't measure, and there are good reasons for criticizing universities and funders for paying too much attention to these numbers. But the impact factor *is* a measure of the frequency with which the average article in a journal has been cited. And it shows that the journals where articles get the most citations on average and the journals that get the most citations in absolute numbers are currently overwhelmingly subscription journals, not open access journals.

The citation advantage is important because researchers want to reach as many readers as possible with their findings, but they also want to spend their time reading other people's research as wisely as possible. And visibility is not only a matter of free access; it is also a matter of appearing in journals or on platforms that are interesting, relevant, and trustworthy. For most researchers, that means trying to publish in the most reputable and highest-ranked journals in their field — and reading those same journals. Such journals are often published by professional societies and are generally subscription journals.

Open access publishing is indeed growing. In 2016, nearly 19% of all articles were made immediately available at the time of publication either in open access journals (15%) or in subscription journals with an option for the author to pay a fee to make an individual article open access ("hybrid" journals).[7] But these percentages also indicate that 17 years after the BOAI, the majority of scientists still prefer to submit their work to subscription journals.

UNFORESEEN OBSTACLES?

So the evidence to date does not confirm the hypothesis that the Gold Open Access publication model will advance science and be an unprecedented public good. Why not?

First, it may be that embracing a specific business model (in which the author or funder pays) and insisting that there be unrestricted reuse of published articles was not the best strategy for reaching the larger goal: giving access to research articles to as many people as possible in order to accelerate research and advance science. High subscription costs are a real problem that has developed over decades and that is linked to, among other things, the professionalization of science and science communication. Most professional societies have let publishing houses assume responsibility for the production of their journals, including many of the editorial processes, while the writing and peer-review processes have remained largely unchanged — usually provided by academics free of charge. It is understandable that academic institutions became frustrated when subscription fees climbed so high that they were unable to "buy back" journals they had helped to produce. But that problem was a matter of pricing, not a consequence of the subscription model itself.

It may also be that the open access movement underestimated the difficulty and costs involved in recreating a publishing landscape with the same variety and quality of journals, using a different business model. A model in which the author or funder pays for publication or simply deposits papers in a repository has served some sciences well. The best example is arXiv.org, established in 1991 with a focus on high-energy physics. It now covers many areas of mathematics, physics, computer science, and more and provides open access to 1.5 million papers.[8] In other sciences — medicine, for example — there are some good reasons why journals should not be dependent on direct payment from authors and funders of research. These parties may have strong interests (financial or intellectual) in the publication of certain results, and the results may affect people's health or health care. It is important that editorial processes and decisions are — and are perceived as — completely independent of the interests of authors and funders.

A subscription-based model may also be the only model that can finance highly selective journals with comprehensive editorial processes and quality control. Given that such journals pay editors and statisticians who objectively assess the importance of a research question and the veracity of researchers' claims and employ essential production staff who ensure the accuracy, clarity, and accessibility of the information, author fees in such journals would be prohibitive for most researchers. The economics may change over time, of course, but that is the current reality.

Second, the Internet has developed in ways that very few people anticipated in 2001. At that time, only 10 years had passed since Tim Berners-Lee and Roger Cailliau submitted their (very modest) proposal to their superiors at CERN (the Conseil Européen pour la Recherche Nucléaire) called "WorldWideWeb: Proposal for a HyperText Protocol."[9] Since then, the Internet has indeed transformed our lives and the way we do many things, including science. But it has done so in ways we never imagined. Experiments with what would later be called social media and smartphones had just gotten started in 2001. Facebook was introduced in 2004, YouTube in 2005, Twitter in 2006, and the iPhone in 2007.

In 2001, we were optimistic and enthusiastic about the Internet and what it could do: information and communication could be free, and power decentralized. John Perry Barlow wrote his "Declaration of Independence of Cyberspace" very late one night during the World Economic Forum in Davos in 1996.[10] We had never heard of Internet trolls, fake news, fake science, fake journals, or fake peer review. And we couldn't imagine a "dark web" where child pornography was distributed anonymously, where terrorist organizations such as ISIS could recruit new members, where identities and property could be hidden and stolen and could influence elections and threaten the concept of democracy.

Most of us still appreciate the openness and ease of communication provided by the Internet, but we now understand that freedom and openness don't in any way guarantee quality or truthfulness. We realize that there is a vast amount of free content online — including scientific "information"; much of it is incorrect or misleading, and it is not self-correcting, as we might have hoped it would be. We recognize that the Inter-

Plan S Principles.*

After 1 January 2020 scientific publications on the results from research funded by public grants provided by national and European research councils and funding bodies, must be published in compliant Open Access Journals or on compliant Open Access Platforms.

In addition:

- Authors retain copyright of their publication with no restrictions. All publications must be published under an open license, preferably the Creative Commons Attribution Licence CC BY. In all cases, the license applied should fulfil the requirements defined by the Berlin Declaration;
- The Funders will ensure jointly the establishment of robust criteria and requirements for the services that compliant high-quality Open Access journals and Open Access platforms must provide;
- In case such high quality Open Access journals or platforms do not yet exist, the Funders will, in a coordinated way, provide incentives to establish and support them when appropriate; support will also be provided for Open Access infrastructures where necessary;
- Where applicable, Open Access publication fees are covered by the Funders or universities, not by individual researchers; it is acknowledged that all scientists should be able to publish their work Open Access even if their institutions have limited means;
- When Open Access publication fees are applied, their funding is standardised and capped (across Europe);
- The Funders will ask universities, research organisations, and libraries to align their policies and strategies, to ensure transparency;
- The above principles shall apply to all types of scholarly publications, but it is understood that the timeline to achieve Open Access for monographs and books may be longer than 1 January 2020;
- The importance of open archives and repositories for hosting research outputs is acknowledged because of their long-term archiving function and their potential for editorial innovation;
- The 'hybrid' model of publishing is not compliant with the above principles;
- The Funders will monitor compliance and sanction non-compliance.

* From Science Europe (https://www.scienceeurope.org/wp-content/uploads/2018/09/Plan_S.pdf).

net needs some kind of governing structure, but experts in Europe, China, and the United States think quite differently about what good governance might look like.[11] We like the free content available on YouTube, Facebook, and blogs, but we are happy to subscribe to Netflix, TV networks, and newspapers, too. Most of us are willing to pay for curated and enhanced content, while we also appreciate experimentation with new forms of information and communication. Now we know that there is no such thing as a free lunch, even on the Internet. Free-to-the-reader means that somebody somewhere is paying — usually to exert an influence on the content and its presentation.

PLAN S

All of which makes this a surprising time to decide that one way of disseminating information is superior to others and to insist that scientific content should be "free" online. But that is exactly what the European Plan S aims to do (see box). The plan was launched in September 2018 by Science Europe (an association of European research institutions and funding organizations) and is supported by several national and European research councils and funders.[10] The plan's main goal is to compel an immediate transition to an open access publishing model by making it a requirement for researchers: "After 1 January 2020 scientific publications on the results from research funded by public grants provided by national and European research councils and funding bodies, must be published in compliant Open Access journals or compliant Open Access Platforms." According to Michael Eisen, one of the founders of the open access movement, "The only way to achieve universal open access to the scientific literature is for research funders to require it of their grantees."[12]

In other words, since the transition to open access journals didn't happen by itself, European countries will deny public funding to researchers who don't agree that it is the best publication model.

That funders — public or private — want the scientific community and the public at large to have access to the result of the research they fund is understandable, but there are many ways to provide such access. Publishing in open access journals is one. Another is to publish in hybrid journals — subscription journals that allow authors to publish individual articles under an open access license.[13] A third option is the one that the *Journal* uses: remaining a subscription journal but providing free access to research articles. About 98% of the research published in the *Journal* since 2000 is free and open to the public. Research of immediate importance to global health is made freely accessible upon publication; other research articles become freely accessible after 6 months.

But these second two options are not compliant with Plan S, whose website explains that "There is no valid reason to maintain any kind of subscription-based business model for scientific publishing in the digital world, where Open Access dissemination is maximising the impact, visibility, and efficiency of the whole research process."[14] This statement is not backed by any evidence, and there are in fact a couple of quite

valid reasons, as mentioned above, why it is likely not to be true. Many scientists want their work to be vetted and endorsed by third parties with a reputation for quality and independence; such an endorsement comes from many sources, including long-established journals.

Open access to research articles is a goal that both scientists and the public will support. But eliminating subscription-based publication models without having alternatives in place that can reliably produce independently vetted, cautiously presented, high-quality content might have serious unintended consequences for the integrity of the scientific literature.

Disclosure forms provided by the author are available at NEJM.org.

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