Clinical Biochemistry 50 (2017) 651–655

Contents lists available at ScienceDirect

Clinical Biochemistry

journal homepage: www.elsevier.com/locate/clinbiochem

Review

The emerging landscape of scientific publishing

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A B S T R A C T

We present emerging models of publishing which have grown from the phenomenon of open access, the changing role of peer review in the scientific process and the new position of the impact factor. We juxtapose the new models of paid review, eponymous review, no review, post publication review and light review with the classic model which has dominated for a century, detailing advantages, problems and examples of each model to provide a comprehensive overview of the changing landscape of scientific publishing.

1. Introduction

In the world of biomedical sciences, publishing papers in a scientific journal is the path to sharing research with the world and receive recognition for hundreds of hours of work, research, writing and contributions to science. Published papers are the core of grant applications, prizes, employment, and in many ways, a scientist's career (Fig. 1, Table 1).

The first English-language scientific journal *Philosophical Transactions* was published in 1665 (http://rstl.royalsocietypublishing.org/) and since then scientific publishing has grown to encompass thousands of journals with topics ranging from all of life such as *Nature* to specific organs like *Kidney International*. Some journals are published weekly while others are published only once or twice. Some journals such as *The New England Journal of Medicine* have been published for over 200 years (http://www.nejm.org/page/about-nejm/history-and-mission.), while new journals are founded every year. Some journals are distributed by print while virtually all are available online. Some are only accessible through a subscription (closed access) while others can be read by anyone with an internet connection (open access).

In this paper, we would like to elucidate the changing landscape of scientific publishing as it stands in 2017. We describe the impact factor and its relevance, different types of publication (classic, preprints, light peer review, post publication peer review, open access, closed access) while commenting on the evolution of peer review in the scientific process. We believe our analysis is of value because it details a fundamental purpose of science: sharing discoveries and knowledge with the world.

2. The journal impact factor

Conceived of by Eugene Garfield in 1955, the Journal Impact Factor (JIF) has been used by the scientific community as the ubiquitous yardstick of publication quality for decades [1]. The impact factor calculation is simple and unnuanced: the number of citations accrued by the journal's papers over a specified period is simply divided by the number of papers published in the journal [2].

Researchers across the scientific world clamor for acceptance into 'high impact journals' creating fierce competition. *The New England Journal of Medicine*, *Nature* and a few other journals have very high impact factor (> 35) with a corresponding rejection rate of > 90%. Publication in these extremely selective and prestigious journals is often a catalyst for career progression, performance pay and research grants.

Over the last decade, the impact factor has garnered a significant amount of contention and criticism from researchers who argue their work is judged not by their writing and results, but by the impact factor of the journal it is published in [3–6]. They argue the metric is simple, crude and misleading with a disproportionate impact on scientists' position in the field [6–8].

Furthermore, the prevalent use and perceived value of the JIF fuels the myth that publication in a high impact journal correlates to a high impact paper. In fact, a 2016 study by Curry et al. of citations of 2013–2014 papers published in 11 journals (including *Nature*, *Science* and *PLOS*) revealed that three quarters of the published papers gathered fewer citations than the impact factor of their journal: 74.8% of *Nature* papers received fewer citations than its impact factor of 38.1 while 75.5% of *Science* papers were cited below its impact factor of 34.7. Highly cited papers in these journals explained this disconnect: one

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http://dx.doi.org/10.1016/j.clinbiochem.2017.04.009
Received 12 April 2017; Accepted 14 April 2017
Available online 20 April 2017
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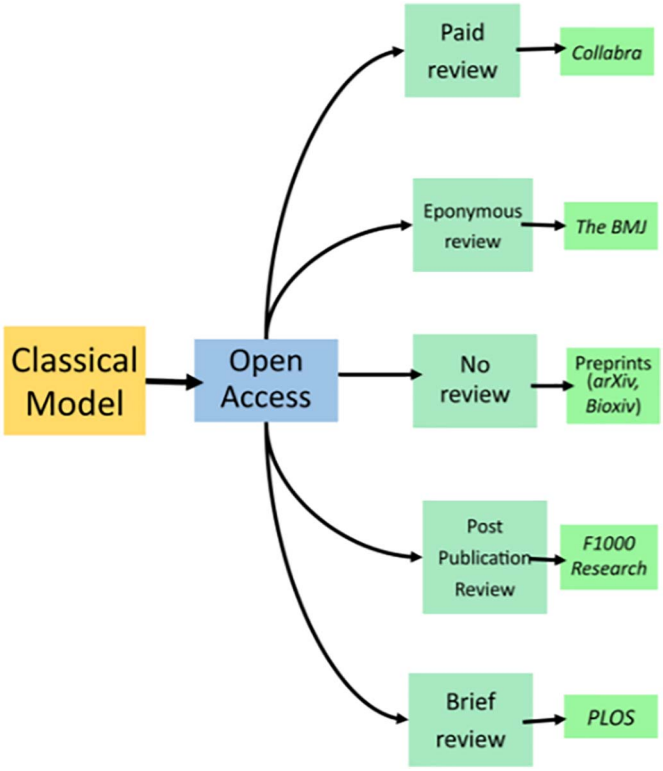

Fig. 1. Characteristics of publication models discussed in this paper.

Table 1
Characteristics of the publication models discussed in this paper.

	Examples					
	Classic (Nature, The Lancet etc.)	Collabra	The BMJ	F1000 Research	PLOS	Preprints (Bioxiv, arXiv, etc.)
Open access		✓	✓	✓	✓	✓
Publication fees				✓	✓	
Prepublication peer review	✓	✓	✓		✓	
Complete peer review	✓	✓	✓	✓		
Anonymous peer review	✓	✓			✓	
Paid/rewarded peer review		✓		✓		

Nature paper was referenced 905 times while another *Science* paper amassed 694 citations, inflating each journal's impact factor [9].

Despite these fundamental problems, the JIF continues to hold sway. According to freelance Indonesian science journalist Dyna Rochmyaningsih, this mindset exacerbates publishing problems in the developing world. In Indonesia, scientists who publish in international journals can receive up to 100 million rupiah, correlated with the journal's impact factor. Equivalent to US $4700, this is ten times the monthly pay of a scientist in a government agency. Though these grants allow scientists to invest in long term projects, bureaucracy means the money can arrive many months late, forcing scientists to struggle to produce research which would qualify them for grant money the next year. Instead of blind reliance on the impact factor, Ms. Rochmyaningsih is advocating for a stronger connection between researchers and policy makers which she believes will not only increase Indonesia's weight in the scientific community but fuel research addressing domestic issues such as filariasis and malaria [10].

In response to all these concerns, the scientific community is beginning to move away from the impact factor towards other metrics [11], including article specific metrics such as PDF downloads or views [12]. In December 2016, Elsevier, publisher of over 2500 scientific journals (https://www.elsevier.com/connect/elsevier-publishing-a-look-at-the-numbers-and-more) introduced CiteScore as a competitor to the JIF. It uses the same calculation as its rival however it counts all documents as potentially citable; not just journal articles but editorials, corrections and letters to the editor. However, these items are much less cited, lowering the score of many journals. Under the JIF metric, *The Lancet* scores 44 however in CiteScore it plummets to 7.7. Some scientists worry this will stem the publication of non-research documents for fear of lowering journals' CiteScore index while others are skeptical because it was created by an influential publisher [13]. Others question whether it is of any use at all.

3. Classic closed access publishing process

The publishing process researchers are familiar has been around since the twentieth century, about as long as the impact factor. Authors submit their paper to a scientific journal, then the editor sends it to two or three experts in the field [14]. These “peer reviewers” are the hallmark of this publishing process; their job is to carefully read the manuscript, looking for adherence to ethical/scientific standards, quality of research and writing and the significance of results. Finally, they write a report detailing whether the paper should be accepted, published with revisions or rejected. This report is sent to the journal editor to make the final decision which in our experience is almost always in agreement with the reviewers [14]. Often a paper must be submitted to several journals before it finds its haven, and this process can take years [15].

This “classic” system has been traditionally considered the gold standard of scientific publishing [16]. At its finest, peer review is a detailed, holistic process: a carefully considered, timely analysis of the quality of the research and writing by a fair, unbiased expert reviewer. The data, citations and analyses are poured over and the reviewer provides constructive feedback to the paper's authors [16]. When done consistently and correctly, peer review forms the cornerstone of scientific publication [17] and upholds science's self-critical, self-assessing nature, serving as a golden seal to protecting journals from unethical, incorrect or just irrelevant science [18].

4. Eponymous vs anonymous review

Peer review of a manuscript can take anywhere from three to beyond twelve hours, however experts are rarely credited for their work [14]. In virtually all “Classic” journals, peer review is anonymous (single blinded) and the pages of insight and commentary written by the reviewer do not go beyond the authors and the editor. Advocates for this system argue it protects the reviewers, allowing them to give an honest review without fear of repercussions or bias. One author, Karim Khan, compares closed peer review to democracy, describing it as “almost fatally flawed, but better than any alternative” [19].

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