

Special Article  
Editing, Writing &  
Publishing



# Innovative Strategies for Peer Review



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**Received:** Aug 29, 2019

**Accepted:** Mar 16, 2020

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**Disclosure**

The author has no potential conflicts of interest to disclose.

## ABSTRACT

Peer review is a crucial part of research and publishing. However, it remains imperfect and suffers from bias, lack of transparency, and professional jealousy. It is also overburdened by an increasing quantity of complex papers against the stagnant pool of reviewers, causing delays in peer review. Additionally, many medical, nursing, and healthcare educators, peer reviewers, and authors may not be completely familiar with the current changes in peer review. Moreover, reviewer education and training have unfortunately remained lacking. This is especially crucial since current initiatives to improve the review process are now influenced by factors other than academic needs. Thus, increasing attention has recently focused on ways of streamlining the peer review process and implementing alternative peer-review methods using new technologies and open access models. This article aims to give an overview of the innovative strategies for peer review and to consider perspectives that may be helpful in introducing changes to peer review. Critical assessments of peer review innovations and incentives based on past and present experiences are indispensable. A theoretical appraisal must be balanced by a realistic appraisal of the ethical roles of all stakeholders in enhancing the peer review process. As the peer review system is far from being perfect, identifying and developing core competencies among reviewers, continuing education of researchers, reviewer education and training, and professional engagement of the scientific community in various disciplines may help bridge gaps in an imperfect but indispensable peer review system.

**Keywords:** Peer Review; Open Access Publishing; Peer Reviewer; Publications; Education; Bias

## INTRODUCTION

Peer review plays a pivotal role in scientific research and scholarly publishing. However, recent innovations in peer review may not be well known to various constituents of the academic community. More importantly, various elements outside the academe now shape these recent innovations in peer review. Although a fool-proof arrangement is yet to be established, peer review is considered to be the gatekeeper of science on the whole. Sadly, it appears to have moved forward at a turtle pace compared with the rapid progress in research.<sup>1</sup> It is still far from being perfect and suffers from bias, lack of transparency, rational

cheating, plagiarism, professional jealousy, hidden conflict of interest, fake peer reviewers, and false reports.<sup>2-4</sup> Moreover, the peer review system is overwhelmed by the growing number of complex papers against the stagnant pool of reviewers, delaying peer review.<sup>5</sup>

Various factors aggravate the delay and quality of peer review. These include requests for multiple revisions and the lack of time for reviewers to read the paper, as well as the shift to digital publishing which drains human and technical resources from the enormous publishing workload.<sup>6,7</sup> To overcome these problems, a more streamlined reviewing process and innovative approaches to peer review have increasingly drawn attention.<sup>5</sup> To identify relevant articles on innovative strategies for peer review and reviewer competency, we adhered to the search strategy recommended for narrative reviews by Gasparyan et al.<sup>8</sup> We searched through MEDLINE, Embase, and Scopus databases using the following keywords: peer review, peer review innovations, peer review models, open access publishing, publications, education, review bias, peer reviewer, reviewer competency, and reviewer training. This article provides an overview of the innovative strategies for peer review and perspectives to consider when making changes to the peer review process.

## PEER REVIEW APPROACHES

Peer review can be divided into two broad categories, traditional peer review and open peer review. Traditional peer review consists of in-house assessment by journal editors, evaluation by external peer reviewers chosen by the editor, and final assessment by the chief editor. Articles undergo rigorous internal and external analyses before acceptance. An initial editorial appraisal allows the filtering of low-quality submissions. The review process is confidential and the reviews are not published.<sup>9,10</sup>

Open peer review discloses the names of the editors and reviewers handling the paper to the authors. The open identities and reports are thought to increase transparency and temper strong criticism. They may also improve the quality of reviews, avoid redundant reviews, speed up publication, and incentivize reviewers. Open peer review aims to facilitate more participation between reviewers and authors, interactive peer review in the form of digital discussion, and collaborative review of preprints. This platform is basically similar to traditional peer review, but the articles are published online and undergo several open peer reviews as managed by the editor.<sup>10-12</sup> A comparative summary between traditional peer review and open peer review is shown in **Table 1**.

## PEER REVIEW INNOVATIONS

The current peer review innovations described by Tennant et al.<sup>7</sup> include pre-peer review commenting, pre-publication peer review, post-publication peer review, post-publication commenting, collaborative review, portable review, recommendation services review, and decoupled post-publication review. Pre-peer review commenting involves the informal commenting or discussion on a publicly available pre-publication manuscript draft. Pre-publication peer review consists of a formal and editorially invited evaluation of research by selected experts in the relevant field. Post-publication peer review comprises a formal and optionally invited evaluation of research by selected experts in the relevant field after publication. Post-publication commenting consists of an informal discussion of published

**Table 1.** Comparative summary between traditional peer review and open peer review

Peer review approaches	Openness	Anonymity	Accountability	Bias	Time	Incentive
1) Traditional peer review <ul style="list-style-type: none"> <li>• Assessment by editors</li> <li>• Evaluation by reviewers</li> <li>• Final decision by chief editor</li> </ul>	<ul style="list-style-type: none"> <li>- Review confidential</li> <li>- Reviewers/reports not published</li> </ul>	<ul style="list-style-type: none"> <li>- Single-, double- or triple-blind review</li> </ul>	<ul style="list-style-type: none"> <li>- Author-reviewer interaction hidden</li> <li>- Strong criticisms may be given</li> <li>- Less accountability (nonconstructive criticisms)</li> </ul>	<ul style="list-style-type: none"> <li>- Editorial decision not public</li> <li>- Review quality may be low</li> <li>- Reviews may be redundant</li> </ul>	<ul style="list-style-type: none"> <li>- Reviewing time varies</li> <li>- Publication speed based on reviewing time</li> <li>- New review in new journal</li> </ul>	<ul style="list-style-type: none"> <li>- Reviewers' names listed in dedicated acknowledgement page of journal</li> </ul>
2) Open peer review <ul style="list-style-type: none"> <li>• Similar to traditional review</li> <li>• Articles published online</li> <li>• Several open peer reviews as managed by editor</li> </ul>	<ul style="list-style-type: none"> <li>- Review made public</li> <li>- Reviewers and authors known</li> </ul>	<ul style="list-style-type: none"> <li>- Editors and reviewers disclosed to authors</li> </ul>	<ul style="list-style-type: none"> <li>- Author-reviewer interaction transparent</li> <li>- Strong criticisms tempered</li> <li>- Constructive criticisms encouraged</li> </ul>	<ul style="list-style-type: none"> <li>- Editorial decisions made public</li> <li>- Review quality enhanced</li> <li>- Redundant reviews avoided</li> </ul>	<ul style="list-style-type: none"> <li>- Speeds up publication</li> <li>- Shortens reviewing time</li> <li>- Avoids delays and new reviews</li> </ul>	<ul style="list-style-type: none"> <li>- Reviewers' names and their reports published alongside the article</li> </ul>

research independent of any formal peer review. Collaborative review involves manuscript assessment wherein referees, editors, and external readers provide interactive comments leading to a consensus decision and a single set of revisions. Portable review means the authors pay a company (e.g., Rubriq) for a standard single-blind review that they can submit with the paper to collaborating journals. Although this may cut down redundant reviews,<sup>13</sup> it can also distract focus on publishing good science and purely intellectual objectives to non-academic objectives (e.g., monetary gains) from peer-reviewing.<sup>4</sup> Recommendation services review involves post-publication evaluation and recommendation of significant articles, often through a peer-nominated consortium. Decoupled post-publication review consists of adding notes directly to the highlighted sections of the work. These added notes can be kept private or made public.

Other innovations to peer review include cascading peer review, independent peer review (e.g., Rubriq and Peerage of Science), and interactive peer review. In Cascading peer review, rejections are avoided by redirecting peer-reviewed but rejected papers to a more suitable publication venue.<sup>14</sup> The consortia enable papers with the referee reports to move easily between publishers, reducing time and expense of repeated evaluation. Some pass on the peer reviews with the rejected papers.<sup>13</sup> Occasionally, reviews from other journals accompanying manuscripts rejected are used for other journals.<sup>15</sup> In independent peer review (e.g., Rubriq and Peerage of Science), a number of companies provide pre-submission peer review for a fee (e.g., Rubriq) or a submission supplementary material.<sup>13,16</sup> Thus, reports from commercial reviewer platforms are used to assist in peer review.<sup>17</sup> This involvement of commercial refereeing bodies allows the dissociation of review from the journal publishing the article, thereby facilitating a faster review (e.g., Rubriq, Peerage of Science, Axios Review) or the detection of integrity issues (e.g., Research Square).<sup>18</sup> Some companies use an online “scorecard”<sup>15</sup> to determine strengths and weaknesses of a paper.<sup>19</sup> For Peerage of Science, the fee is paid by the journal which publishes the offering.<sup>15</sup> In interactive peer review, the reviewers interact online with the authors and other interested scientists for a more open and collaborative review. Although this is more supportive, it can also prematurely expose a study or challenge experts.<sup>20</sup> A comparative assessment of these peer review innovations in relation to open access publishing features is shown in **Table 2**.

**Table 2.** Comparative assessment of peer review innovations in relation to open access publishing features

Peer review innovations	Openness	Anonymity	Accountability	Bias	Time	Incentive
	Review content made public Reviewers and authors known	Editors and reviewers disclosed to authors	Author-reviewer interaction transparent Constructive criticisms increased	Editorial decisions made public	Reviewing time shortened Delays or new reviews avoided	Recognition or credit given to reviewers
1) Pre-peer review commenting : Informal commenting or discussion on publicly available pre-publication draft	Yes	Yes	Yes	Yes	Yes	Yes or No
2) Pre-publication peer review : Formal and editorially invited evaluation of research by selected experts in relevant field	Yes	Yes	Yes	Yes	Yes	Yes or No
3) Post-publication peer review : Formal and optionally invited evaluation of research by selected experts in relevant field after publication	Yes	Yes	Yes	Yes	No	No
4) Post-publication commenting : Informal discussion of published research independent of any formal peer review	Yes	Yes	Yes	No	No	No
5) Collaborative review : Referees, editors, and external readers provide interactive comments leading to consensus decision and single set of revisions	Yes	Yes	Yes	Yes	Yes	Yes or No
6) Portable review : Authors pay a company (e.g., Rubriq) for standard single-blind review that they can submit with the paper to collaborating journals	Yes or No	Yes or No	Yes or No	Yes or No	Yes	Yes or No
7) Recommendation services review : Post-publication evaluation and recommendation of significant articles, often through peer-nominated consortium	Yes	No	Yes	No	No	No
8) Decoupled post-publication review : Addition of notes directly to highlighted sections of work which can be kept private or made public	Yes or No	Yes	Yes	Yes	No	No
9) Cascading peer review : Rejections avoided by redirecting peer-reviewed but rejected papers to more suitable publication venue	Yes	Yes	Yes	Yes	Yes	No
10) Independent peer review : Companies provide pre-submission peer review for a fee (e.g., Rubriq) or the fee is paid by the journal which publishes the offering (e.g., Peerage of Science)	No	No	No	No	Yes	No
11) Interactive peer review : Reviewers interact online with authors and scientists for more open/collaborative review	Yes	Yes	Yes	Yes	Yes	Yes or No

## PEER REVIEW ANONYMITY

Peer review involves different types of blinding. Blinding that is related to the identifiability of reviewers, authors, and editors includes single-blind peer review, double-blind peer review, and triple-blind peer review. Blinding that is related to the type of peer review include blinding in private open peer review, unattributed peer review, optional peer review, pre-publication open peer review, post-publication open peer review, and peer review by endorsement. In single-blind peer review, the authors are known but the reviewers are anonymous. Thus,

strong or biased comments are occasionally encountered.<sup>7,9</sup> In double-blind peer review, the reviewers and authors are anonymous.<sup>10,11</sup> This achieves equality in gender/ethnicity,<sup>5,21</sup> and reduces bias,<sup>5</sup> but it may lessen conflicts of interest awareness.<sup>9</sup> In triple-blind peer review, the authors and their affiliations are kept hidden from the editor.<sup>7,11</sup> This blinding therefore runs counter to open peer review.<sup>11</sup> For blinding in private open peer review, the names of the authors and reviewers are revealed upon their consent. This becomes advantageous as the authors and reviewers can interact freely. For blinding in unattributed peer review, the reports of the reviewers are made public anonymously upon their consent after publication.<sup>7</sup> The disadvantage of this blinding is its failure to give credit to the reviewers. For blinding in optional peer review involving single-blind peer review, the reviewers can make their review and name public. This may avoid bias and promotes incentivization of the reviewers.<sup>7</sup> For blinding in pre-publication open peer review, the referees are disclosed to the authors before publication. After publication, the peer review history and referees' names are made public.<sup>7</sup> This gives credit to the reviewers. For blinding in post-publication open peer review, the referees' names and reports are made public.<sup>22</sup> An advantage of this blinding is that critiques from other researchers can be also added.<sup>23</sup> For blinding in peer review by endorsement, the reviews are pre-arranged and the article is eventually approved by the reviewers.<sup>7</sup> This blinding may be unfair if the studies are of poor quality.

## PEER REVIEW DELAYS

The peer review process often takes about 18 months to complete, thus there have been urgent calls for a faster, more open, and less cumbersome review procedure.<sup>21,24</sup> However, selecting the most suitable reviewers can also take time because of their different interests, abilities, or analytical skills.<sup>6</sup> Many reviewers consider reviewing papers for free as a thankless job<sup>24</sup> and wittingly or unwittingly incur in delays. Their decision to accept review invitations is usually influenced by the journal prestige and opportunity to network with the editor.<sup>25</sup> However, the increasing number of questionable papers discourages them from readily accepting invitations.<sup>1</sup> They also decline to review because of lack of time or insufficient expertise in the field.<sup>26</sup>

Peer review delays inevitably occur when reviewers are burned out from uncompensated over-reviewing<sup>21</sup> or when they are imposed deadlines.<sup>6</sup> Regrettably, some reviewers steal the ideas of competing authors and slow down the review process by requesting unnecessary revisions and additional experiments.<sup>3</sup> There is also the wasted time that elapses before an editorial decision can be made or before a paper even gets read by the reviewers.<sup>6</sup> Without the benefit of cascading peer review, every submission of a rejected paper means another redundant review which further delays publication, costs time and money, and frustrates the authors.<sup>13</sup>

## FUTURE PEER REVIEW MODELS

Over the years, the strategic shift from traditional to open access peer review to sustain the increasing rate of paper submissions has become evident. This development has spurred changes in the review process in terms of shortening the review time, enforcing deadline adherence, providing reviewer incentives, including early career researchers as reviewers, improving editorial management, and opening peer review.<sup>27</sup> The idea of standardization of peer review has also been proposed.<sup>16</sup> Some of the more radical publishing approaches

**Table 3.** Comparative assessment of future peer review models in relation to open access publishing features

Future peer review models	Openness	Anonymity	Accountability	Bias	Time	Incentive
	Review content made public Reviewers and authors known	Editors and reviewers disclosed to authors	Author-reviewer interaction transparent Constructive criticisms increased	Editorial decisions made public	Reviewing time shortened Delays or new reviews avoided	Recognition or credit given to reviewers
1) Reddit model : Platform for comments and original or linked content	Yes		Yes			
2) Stack exchange model : Network of websites of question and answer sites	Yes		Yes			Yes
3) Amazon model : Model for posting reviews of published materials	Yes					
4) GitHub model : Open-source distributed version control system with features transferable to peer-review system	Yes				Yes	
5) Hypothesis model : Web annotation tool for interactive education and collection of peer perspectives	Yes		Yes			
6) Wikipedia model : Collaborative authoring and review system	Yes				Yes	
7) Blockchain model : Technology for possibly creating tokenized peer review system	Yes					Yes
8) AI-assisted peer review : Used for recognizing images, recommending content, detecting fraud, evaluating teaching and assessment, or detecting plagiarism; requires human final judgement	Yes					
9) Hybrid peer review platform : Consists of harmonization, certification, and incentivization	Yes					Yes

Blanks: No basis for making a present assessment.

currently applied involve open peer review in which anonymous reports are made public, publish first and peer review later, and the use of an independent validation service. The newer publishing approaches include complete reliance on a validation step and third-party peer review.<sup>28</sup> The future peer review models that have recently been described include the Reddit, Stack Exchange, Amazon, GitHub, Hypothesis, Wikipedia, Blockchain, AI-assisted peer review, and Hybrid peer review models.<sup>7</sup> A comparative assessment of these models in relation to open access publishing features is shown in **Table 3**.

## REVIEWER INCENTIVES

Peer review has often been considered a thankless undertaking and in many cases biased.<sup>4,7</sup> Its lack of incentives and insufficiency in improving academic reputation remain as key limitations.<sup>29</sup> Thus, various nonfinancial<sup>30</sup> and crediting incentives,<sup>5</sup> as well as financial incentives<sup>7</sup> have been attempted to overcome these and other limitations.

Nonfinancial incentives may come in the forms of frequent reviewer invitations, being up-to-date with research developments, opportunities to influence science, increased acumen

in reviewing, free journal access or subscription, access to databases/research platforms and digital libraries, acknowledgment in journal websites, publicized reviews, letter of thanks, certificates of excellence, and editorial board appointment.<sup>31</sup> Crediting incentives may be given by formally recognizing the reviewing work and linking peer review activity to ORCID records using DOIs.<sup>5,26</sup>

Financial incentives can be received through the Rubriq system by providing pre-publication reviews or from compensation derived from the article processing charge.<sup>15,30</sup> Although cash incentives can hasten reviews, many journals cannot realistically afford it. Cash incentives may also affect the quality of review, transform the review process into business,<sup>30</sup> or damage the moral sentiments of researchers.<sup>6</sup> Other forms of financial incentives include waiver of publication charges and free access to paid articles.<sup>32</sup>

## REVIEWER TRAINING AND CORE COMPETENCIES

Training and adherence to core competencies of reviewers are crucial in producing high-quality reviews. Training is achieved when reviewing author instructions from journals, receiving guidance from academic peers,<sup>25</sup> or continuing education on digitization and open access.<sup>33</sup> The creation of a common database of potential reviewers (i.e., Global Reviewer Index Directory) that could be shared across a publishing house or within a professional body has been proposed. Unfortunately, this was not realized. However, Publons can be used as a database of potential reviewers. In fact, training and orientation through the Publons Academy can be received to further develop skills in reviewing.<sup>34</sup>

The Publons Academy helps in training reviewers by verifying and providing recognition of their review activity, which may increase review acceptance, hasten review time, and enhance review quality.<sup>28,32</sup> Publons plays an important role in opening access to the reviewers' comments by improving the transparency of the review process. Publons accomplishes these by offering the publication of full reviews. This opens the whole pre-publication process as well as the identity of the reviewers post-publication. It also provides a platform for discussing the papers and reviews as part of its training. In fact, the Publons Academy provides a free peer review training course on the core competencies of peer reviewing.<sup>35</sup>

Additionally, Publons announces the Peer Review Awards for the top 1% of peer reviewers in each field in the peer review week of September. Official certificates are given to the winners to acknowledge their achievements, and badges are awarded on their profiles. The possibility of including the Publons ranking and awards in the resume when applying for academic positions, fellowships, grants, and continuing professional development is one of the important benefits of Publons. All these initiatives train reviewers to produce good quality reviews, avert reviewing inconsistencies, and avoid abuse of the peer review system.<sup>34</sup>

Core competencies among peer reviewers are based on the recommendations of associations concerned with the integrity of peer review. These associations include the Council of Science Editors (CSE),<sup>36</sup> World Association of Medical Editors (WAME),<sup>37</sup> International Committee of Medical Journal Editors (ICMJE),<sup>38</sup> and Committee on Publication Ethics (COPE).<sup>39</sup> The core competencies commonly recommended by these associations may be categorized as reviewer's responsibilities to the authors, editors, and readers. A summary of these core competencies and reviewer's responsibilities is shown in **Table 4**.

**Table 4.** Summary of the recommended core competencies of reviewers common to the CSE, WAME, ICMJE, and COPE

Reviewer's responsibility	Category	Core competency
To the authors	Study appraisal and feedback	- Provides written, unbiased feedback in timely manner on scholarly merits and scientific value of work
	Quality of review	- Provides high-quality, constructive, and fair reviews
	Confidentiality	- Indicates whether writing is clear, concise, and relevant
	Impartiality and integrity	- Maintains confidentiality of review process
	Timeliness and responsiveness	- Makes comments and conclusions based on objective and impartial consideration of facts, exclusive of personal or professional bias
	Conflicts of interest	- Reveals any conflicts of interest, financial or otherwise, related to particular manuscript
To the editors	Conflicts of Interest	- Points out all potential sources of conflicts of interests
	Compliance with instructions	- Discloses any potential personal or financial conflicts of interest
	Study appraisal and feedback	- Complies with editor's written instructions
	Personal and professional information	- Provides fair, constructive, and informative critique
		- Determines merit, originality, and scope of work
Accountability	- Notes any ethical concerns	
To the readers	Methodology appraisal	- Provides personal and professional information that is accurate and fair representation of his/her expertise, including verifiable and accurate contact information
	Reference citation appraisal	- Responsible for making his/her competence clear to editor
		- Ensures that the study methods are adequately detailed
		- Ensures that the article cites all relevant studies/reports

CSE = Council of Science Editors, WAME = World Association of Medical Editors, ICMJE = International Committee of Medical Journal Editors, COPE = Committee on Publication Ethics.

## APPRAISAL OF PEER REVIEW INNOVATIONS

Overall, the recent transition from traditional subscription to open access publishing has increased the reviewing and publishing options of authors. Now, authors can opt to publish articles that meet the minimum standard and then rely on post-publication review by the scientific community.<sup>26</sup> Authors can also choose journals that use non-selective review. This is a review process wherein reviewers are requested to focus more on the validity of the methods and results of the study. This form of review is also referred to as “impact neutral review” and has been used by a number of open access journals (e.g., *PLOS One* in 2006 and *Frontiers* in 2007).<sup>7,40</sup>

Broader innovations and strategies have also become available to authors according to discipline. These include open review, interactive review wherein editors, reviewers and authors work together to improve the quality of a paper, and informal out of channel reader commentary.<sup>40</sup> Moreover, there are now strategies on introducing paid peer reviews and crediting peer reviewers.<sup>25</sup> This moving away from classical peer review to a more open and interactive peer review may well become an important path for research in the medical and nursing sciences similarly to research in the physical and mathematical sciences. However, this path may initially be long and arduous because of the varied medical and nursing disciplines that require different review processes. Progress is anticipated towards a more diversified open and interactive peer review involving adaptable mechanisms that promote high-quality reviews which highlight study novelty and incentivize reviewers.

Unfortunately, reviewer education and training crucial in sustaining long-term peer review innovations have remained insufficient.<sup>4</sup> What is currently helpful for training and evaluating reviewers are the core competencies set forth by the CSE, WAME, ICMJE, and COPE.<sup>36-39</sup> Moreover, financial incentives have raised legitimate concerns on review fairness and money misappropriation.<sup>1</sup> There is a rightful concern that peer review innovations



involving financial incentives may cater to those with more financial capability.<sup>16</sup> Understandably, this can become unfair or may create a vicious cycle of accepting or rejecting papers simply to maintain journal circulation. There is also the issue of misusing money originally intended for peer review.<sup>16</sup>

Despite the established core competencies for training and evaluating reviewers, their adherence to the rules of honest and transparent review may also be compromised in some Asian countries where fake peer review appears to concentrate. Manipulation can be in the forms of suggesting fake reviewers whose invented e-mail addresses direct the review invitation to the author, creating a peer circle to internally review a co-participant's paper, or paying a third-party agency to provide fabricated reviews. Such manipulation reportedly occurs more with men and accounts for majority of retractions in open access journals with a low impact factor.<sup>41</sup> Consequently, the outcomes of fake peer review are fabricated low-quality publications and retraction.

Regarding peer review transparency, indeed publishing the referees' reports alongside articles and opening authors' and reviewers' identities allow greater participation in open peer review.<sup>42</sup> The study is therefore placed in the context of a discussion, aiming at transparency and collaboration.<sup>43</sup> Although there is a high level of support for opening peer review, this may not always be true for opening reviewers' identities to authors.<sup>44</sup> This is understandable especially in reviews involving no incentives or credits.

What seems to be lacking are studies on improving the competence or selection of reviewers. Currently, there is an increasing trend of requesting authors to suggest peer reviewers, which appears to be beneficial and harmless. However, author-suggested reviewers have been reported to provide reports of comparable quality to non-author-suggested reviewers, although these reports are more likely to recommend acceptance.<sup>45</sup> In this context, the call for ceasing the practice of instructing authors to suggest reviewers or for making it optional<sup>46</sup> to eliminate bias has validity.

The importance of the reviewing guidance of journals should not be overlooked. Guiding reviewers through the review process or leaving them to decide on the appropriate ways of reviewing has been reported to most effectively detect problematic publications, whereas partly guiding reviewers appeared to be least effective.<sup>47</sup> Thus, this aspect should also be scrutinized and improved as it affects the review quality and the ability to detect publication misconduct.

The use of twitter, blogs, and other forms of social media to comment on already published articles has the advantages of transparency and involvement of a wider group of people.<sup>48</sup> There is, however, the risk of receiving irrelevant comments from non-specialist reviewers. This promising form of post-publication peer review deserves more study and application.

Another factor that deserves attention is the increasing availability of biomedical pre-print repositories which serve as a publishing mechanism without the need for traditional peer review.<sup>40</sup> Although these repositories may provide a primary channel of communicating reports without reviewing delays and biases, these reports have in fact not gone through any formal peer reviews. Thus, these reports are not considered published papers in the usual sense of peer-reviewed publications. Such nullification of the peer-review process may have important consequences on evidenced-based medicine.

## PERSPECTIVES IN INTRODUCING PEER REVIEW CHANGES

As with anything new comes important areas that need to be validated. Thus, it is important to determine whether the peer review innovations have been thoroughly tested or not. Specifically, the effects of these innovations on the speed with which articles are published, and on their content and quality need to be confirmed. It is also important to elucidate whether the innovations and incentives have reduced bias against particular categories of authors and have made scientific publishing more accessible. Clarifications of whether the innovations have made it easier to publish replication studies, negative results, and hypotheses that go against mainstream opinion are critical. Overall, it is vital to determine whether the innovations and incentives are more effective than traditional practices in detecting scientific malpractice, improving the quality of accepted papers, and enabling readers to keep abreast with the latest developments in their respective disciplines.

### SUMMARY

The transition from subscription-based to open access publishing has allowed rapid access to research data, global visibility of articles, archiving, and indexing. It has spurred innovations towards open peer review, post-publication peer review, or cascading peer review to credit peer reviewers and address issues of transparency, consistency, cost, and speed. Opening the peer review process makes it more transparent with more filtering opportunities. However, the review quality may be compromised when financial incentives are prioritized. Thus, critical assessments of peer review innovations based on past and presents experiences are indispensable. A theoretical appraisal must be balanced by a realistic appraisal of the ethical roles of all stakeholders in enhancing peer review. At this point, identifying and developing core competencies among reviewers, continuing education of researchers, reviewer education and training, and professional engagement of the scientific community appear to be the best approaches to bridging gaps in an imperfect but indispensable peer review system.

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