PEER REVIEW IN MEDICAL JOURNALS: BEYOND QUALITY OF REPORTS TOWARDS TRANSPARENCY AND PUBLIC SCRUTINY OF THE PROCESS

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ABBREVIATIONS: COI, conflicts of interest; DOI, Digital Object Identifiers; ORCID, Open Researcher and Contributor ID

ABSTRACT

Published medical research influences healthcare providers and policy makers, guides patient management, and is based on the peer review process. Peer review should prevent publication of unreliable data and improve study reporting, but there is little evidence that these aims are fully achieved. In the blinded systems, authors and readers do not know the reviewers' identity. Moreover, the reviewers' reports are not made available to readers. Anonymous peer review poses an ethical imbalance toward authors, who are judged by masked referees, and to the medical community and society at large, in case patients suffer the consequences of acceptance of flawed manuscripts or erroneous rejection of important findings. Some general medical journals have adopted an open process, require reviewers to sign their reports, and links online prepublication histories to accepted articles. This system increases editors' and reviewers' accountability and allows public scrutiny, consenting readers understand on which basis were decisions taken and by whom. Moreover, this gives credit to reviewers for their apparently thankless job, as online availability of signed and scored reports may contribute to researchers' academic curricula. However, the transition from the blind to the open system could pose problems to journals. Reviewers may be more difficult to find, and publishers or medical societies could resist changes that may affect editorial costs and journals' revenues. Nonetheless, also considering the risk of competing interests in the medical field, general and major specialty journals could consider testing the effects of open review on manuscripts regarding studies that may influence clinical practice.

INTRODUCTION. PEER REVIEW: THE BASE OF EVIDENCE-BASED MEDICINE

Medical journals disseminate scientific information that helps understanding, preventing, and treating diseases. Editors decide which data will be available to the medical community and to patients also based on reports of experts in the field who, acting as consultants, verify if research findings meet the necessary standards. Although editors retain the authority and responsibility to override reviewers' recommendations regarding the final disposition of manuscripts, reviewers appear to be influential, and it has been reported that in two top-tier specialty journals a recommendation for rejection or acceptance was eventually accompanied by, respectively, 93% rejection and 67% acceptance rates [1]. Therefore, peer reviewers play a crucial role in the selection of those studies that, once published, will inform health care decisions.

Through the years, the peer review system has undergone increasing enquiry and criticisms, mainly due to the possibility of bias, conscious or unintentional (see, as reviews on the different types of bias, [2-4]) and the considerable effects they can have on the scientific literature that will eventually inform health care decisions [5]. Moreover, when the peer review process fails, there are additional negative consequences, as scientists who got published without deserving it, or scientists who got rejected despite deserving to be published, respectively gain or lose credits incorrectly, and this has an indirect impact on reputation and grants. This causes distortions in the mechanisms through which science self-regulate itself also in terms of resource allocation, and has an indirect effect on the value of knowledge produced by the system.

Modifications of the process have been studied with the goal of improving the quality of reviewers' evaluations and, consequently, that of reports of biomedical studies and of the evidence offered to health care providers, policy makers, and consumers [2,3,6-8]. In

particular, some medical journals have adopted an open peer review system, thus revealing the reviewers' identity to authors [9], whereas reviewers are usually kept anonymous (blind or closed peer review). Given the critical importance of peer review and the potential effect of any editorial decision, recommendations have been made to assess the feasibility of a transition from the blind to the open system also within specialty journals [10,11]. Some advantages and disadvantages of open versus blind pre-publication peer review are here examined.

METHODS

The best quality evidence was selected with preference given to the most recent and definitive original articles and reviews. Information was identified by searches of MEDLINE and references from relevant articles, using combinations of MESH terms “peer review”, “blind peer review”, “open peer review” “medical publishing”, and “conflict of interest". The search was limited to peer-reviewed, full-text articles in the English language. Papers published in the last 20 years were considered. Open pre-publication review (e.g., as adopted by PeerJ) and post-publication review (e.g., as adopted by F1000Research) will not be addressed owing to lack of adequate evaluation in the medical field.

BLIND PEER REVIEW: THE DARK SIDE OF SCIENCE?

In theory, single-blind peer review (reviewers know the authors' identity whereas reviewers are kept anonymous to authors) should allow unconditioned judgments without concerns regarding potential consequences on one's career and personal relationships [12]. This system would protect especially young researchers assessing manuscripts submitted by senior or academically powerful investigators [13]. However, this closed model is not immune from systematic bias, as reviewers may not limit themselves to an objective evaluation of research methodology and findings' validity, but may interpret the study according to personal

convictions or friendship/enmity with authors [9, 14]. This may occur frequently in subspecialty fields, where most experts know each other well. The possibility for authors to suggest/exclude reviewers could hypothetically further complicate the issue, but no differences in quality of reports were observed when reviewers were suggested by authors or by editors [15].

To prevent bias, double-blind peer review (reviewers and authors do not know each other's identity) has been studied or implemented by some general and specialty journals [16-18]. Nonetheless, interested authors can make themselves easily recognizable [19]. Therefore, to achieve adequate blinding, the entire manuscript should be accurately de-identified before sending it out for review, thus imposing a burdensome and costly extra-work to editorial offices. In spite of these efforts, reviewers are still able to identify authors in up to 40% of instances [20]. Independently of the preference expressed by both authors and reviewers, [21] double-blind peer review was not associated with better quality reports compared with single-blind peer review [22-24]. In particular, neither blinding reviewers to authors' identity and provenience of the manuscript, nor asking them to sign their reports, improved the errors' detection rate [17]. Moreover, knowledge of authors and origin of data might be considered important [3].

Finally, neither system prevents the risk of intellectual plagiarism, attempts at delaying manuscript publication, or the influence of financial conflicts of interest (COI). Reviewers must disclose COIs, but it is not always clear if this leads to their exclusion in case of relevant financial ties. For a subspecialty or small journal, finding competent and available reviewers already may be difficult, and selecting only those without financial and non-financial COIs might be impracticable.

PROS AND CONS OF OPEN PRE-PUBLICATION PEER REVIEW

Junior reviewers who have to sign reports on manuscripts written by powerful academicians may refrain from negative judgments because of fear of unfavorable consequences on their career [13]. Senior peers may fear revenges in case of future reversal of roles in manuscript evaluation [12]. Conversely, a sort of reciprocal favoritism may ensue, with a "credit" to be cashed when the reviewer will in turn submit a manuscript indicating the author's name among the suggested reviewers. In other words, once everything is public, scientists could even rationally start to game the system. For instance, considering peer review as a cooperation dilemma, scientists can reciprocate favorable reviews to known reviewers who previously ensured positive reviews to them, and sanction those ones who did not. This can increase evaluation bias [25]. As mentioned before, this may happen also with reviewers' recommendations. However, the fact that studies did not fully capture this effect is due to sample bias, as scientists could play sophisticated reciprocity strategies across different journals, and this is hardly empirically traceable through data on single journals. The above risks may be higher in a specialty field where experts in specific areas of research are limited. Moreover, specialty journals may face increasing difficulties in finding available reviewers [26]. According to Khan [13], one expert out of four already declines the invitation to review by a specialty journal adopting the single-blind system, but this percentage could increase up to 40% in case of open review. In addition to inconveniences for the editorial office, excessive reviewers' self-selection may lead to a further systematic (and undetectable) bias.

In short, there could be a trade-off between full transparency and quality of the process. According to its detractors, open review may thus result in worse reports compared to blind review, but this has not been observed in randomized, controlled trials [10,11, 27]. Noteworthy, a similar study conducted by a specialty journal observed a small difference in the quality of reports in favor of open reviewers [28]. This lack of major differences has been ascribed to the Hawthorne effect, as reviewers allocated to both signed and unsigned groups

142 could have performed better than usual just because they knew they were participating in a
143 trial [10, 28]. However, no such effect was apparent when a group of anonymous reviewers
144 unaware they have been recruited in a study was included [27]. A slight improvement in the
145 quality of reviewers' reports has been observed also in a recent retrospective study comparing
146 open and single-blind peer review in two very similar specialty journals [29]. Moreover,
147 reports of inappropriate or rancorous authors' reactions following an unfavorable open review
148 are exceedingly rare [11], although unblinding reviewers in specialty/subspecialty journals
149 may reveal less safe compared with large general medicine journals.

150 Proponents of open review maintain that masking reviewers identity generates an
151 ethical imbalance, as it is improper to undergo an evaluation by anonymous judges when they
152 know who the "defendants" are [10]. Because a completely closed system (with only an
153 editorial assistant knowing the authors' identity and only the editor knowing the reviewers'
154 identity) is impractical, open peer review would be the only ethically sound option [30]. Open
155 review has been already adopted not only by general medical journals such as The BMJ, BMJ
156 Open, and the Journal of the Royal Society of Medicine, but also by specialty journals,
157 including those within the BMC series.

158 In addition to requesting reviewers to sign their reports, some journals now make the
159 entire pre-publication history of accepted manuscripts available online [31]. Thus, the
160 scientific community, and not only authors, may read the reviewers' and editors' comments,
161 the authors' response and the original and revised versions of the manuscript. The advantages
162 of such a policy are multiple, and include accountability of reviewers. Owing to reputational
163 costs, the risk of favorable judgments of methodologically flawed studied or provision of
164 shallow reviews should be reduced [32]. Reviewers' reports could be publicly evaluable in
165 order to verify if methodological shortcomings were correctly identified and if the suggested
166 modifications were appropriate or unwise. Moreover, posting of pre-publication histories,

increases also editors' accountability for their choice of reviewers, and decisions regarding manuscripts [6, 30, 32].

Peer reviewing papers is one of the scientists' most important tasks, for which they are not paid and rarely get credit. An open review system linking reviews to published papers would give credit to peers undertaking a job which implies opportunity costs, but no obvious recognition [6, 30, 32]. Pre-publication reviews are usually discarded after articles are published. Sometimes this means that time, expertise, efforts, valuable content and insight are wasted [33]. Posting reviews could allow Internet access through common search engines [30]. Signed reports could help build the reviewer’s reputation and curriculum, especially if standard evaluative instruments are systematically used [34,35] and scores shown, and might constitute a teaching and training modality for junior reviewers and scientists [10]. In addition, if reviews are publicly accessible, the theoretical risk of retaliations by vengeful authors would be counterbalanced by the appreciation of a multitude of colleagues who could influence one's career as much as enemies [32].

Indeed, some initiatives have been recently undertaken with the objective of crediting reviewers. In 2012 Publons [36], an academic networking platform based in New Zealand was launched. Publons enables authors to post their reviews on the platform. Contributions are assigned Digital Object Identifiers (DOI), thus allowing the best reviewers to track and record their reviews for potential inclusion in their curricula [37]. Of note, following the recent integration of Publons with Altmetrics, a new scoring system was developed with the aim of increasing exposure to social networks and to measure alternative impact of the reviews [38-40]. Pre-val is another emerging tool gaining traction in the peer review world. Pre-val, a program working to facilitate transparency and integrity of peer review, has been recently backed by the American Association for the Advancement of Science [41].

Also a scholarly publisher recently explored a new modality to facilitate transparency of the peer review process and to give credit to reviewers. Elsevier launched a pilot trial publishing peer review reports as articles [42]. For five participating journals, selected reviews of accepted articles appear next to their published articles, with a separate DOI, on ScienceDirect [43]. However, editors of participating journals "can" choose to have review reports published, and, although the review reports are freely accessible to all [44], reviewers are given the option to remain anonymous. Moreover, editors' comments and reviewers' comments to the editors are not included [42].

Making peer review reports citable could create an incentive for reviewers. However, this also poses a serious problem, that is, how can journals publish and credit negative reports that led to manuscript rejections? This aspect has further implications, such as inducing reviewers to express negative recommendations in case they prefer not to be exposed to the public. Finally, publishers, especially commercial ones, or scientific societies owners of journals, might be reluctant to accept changes that may increase management costs for editorial offices, and potentially affect revenues from selling of reprints and advertising [45-48]. In fact, particularly in specialty fields, manuscripts regarding trials sponsored by industry might be submitted preferentially to journals with anonymous peer review rather then to those adopting an open review system with links to pre-publication history. In fact, publishers and societies might consider medical journals also as business ventures that must make profits [49,50], and anything that might threaten income, at least in the short term, could be regarded with skepticism.

MEDICAL PUBLISHING, ETHICAL RESPONSIBILITY, AND THE DIFFICULT CHOICE BETWEEN OLD AND NEW MODELS

Substantial differences in the quality of reviewers' reports were not observed in the now numerous primary and secondary studies conducted on the proposed modifications of the peer review process [10,11,15,17,51-54], as methodological shortcomings and study bias often go undetected independently of the system adopted [55]. What can be obtained by reviewers seems to be associated with their knowledge, motivation, and dedication, and not with a specific peer review model.

Additional weaknesses of the closed models were recently uncovered as peer-review frauds based on auto-fabricated reports hacked the publication process [56]. Surprisingly, not only authors were involved but, occasionally, editors as well [56]. Several measures have been suggested in order to increase the overall system safety, including turning off the reviewer-recommendation option, integrating the Open Researcher and Contributor ID (ORCID) to verify reviewers' identities, and reducing the vulnerability of the editorial software [57]. In this regard, the open-review model would further discourage these illegal practices. In fact, the possibility to timely identify fake reviewers would be increased, as personal data and institutional affiliations would undergo public scrutiny in addition to pre-publication editorial check.

Beyond the above aspects and considerations, the open system with posting of prepublication histories indeed changes the overall perspective and the goal itself of peer review, as it brings under the spotlights all the editorial activities linked to article publication, overcoming the limits of an excessive focus confined to reviewers' role [4,30,45,58,59]. Publications greatly influences prescribing patterns and clinical practice. It seems ethically sound that each step that leads to publication of studies that may imply consequences for patients is rendered transparent. Editors decide which manuscripts are to be rejected outright after internal assessment and which are to be sent out for external review, they select reviewers, interpret their comments, and have the power and the responsibility to accept or

override their recommendations [4,6,59]. In a blind system, all these crucial phases are generally kept secret, and this may appear inappropriate. Moreover, much emphasis is put on authors' COIs, but also COIs of editors, associate editors, and reviewers may unduly influence the manuscript fate [4,45,47,60,61]. Furthermore, COIs may be additive, in case reviewers are chosen who share the same competing interests of editorial board members who have the power to take decisions regarding manuscripts. It has been suggested that specialty journals may be at higher risk of COIs compared with general medical journals [62]. In an open system, all COIs would undergo public scrutiny, and authors and readers could also identify COIs that reviewers failed to declare and editors are unlikely to detect [4,30].

Thus, a key aspect of a transition to an open system would be to reveal the identity, the reports, and the competing interests, if any, of all those who influenced acceptance of a manuscript to the entire medical community [4,6,31,32]. According to van Rooyen *et al*. [11] "for important decisions that affect us, we now expect to know who made them and how they arrived at their decision".

CONCLUSION

In medicine, several costly new drugs, devices, diagnostic tools, and surgical procedures are regularly evaluated. The choice among alternatives may imply different effects on the limited financial resources of individual families or public health systems. At the same time, the first Open Payment data shows that several manufacturers of drugs or devices are among the top highest spending US companies by payment to physicians, with orthopedic surgery, internal medicine, cardiology, and psychiatry being the specialties that receive the most payments. In addition, orthopedic surgery, obstetrics and gynecology, gastroenterology, cardiology, and ophthalmology are the specialties with the highest value of shares held by physicians [63]. Therefore, especially in the above fields [26,61,64], the risk of competing

263 interests' influence on medical publishing [4] may constitute an additional good reason why
264 an open review system that links the full prepublication history, including editorial and
265 reviewers' COIs, to selected published articles, could be adopted. This seems particularly
266 important also considering that primary research constitutes the basis for systematic reviews
267 and meta-analyses, which in turn inform clinical practice guidelines. Open review of original
268 trial reports and clinical education articles covering new commercial diagnostic or therapeutic
269 products, i.e., those that could influence patient management, would also further increase trust
270 of the medical community and society in medical journals.

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LEARNING POINTS

- Peer reviewers play a crucial role in the selection of those studies that, once published, will inform health care decisions.
- Although editors retain the authority and responsibility to override reviewers' recommendations regarding the final disposition of manuscripts, reviewers appear to be influential.
- The single-blind peer review system has undergone increasing scrutiny and criticisms, mainly due to the possibility of bias and the considerable effects they can have on the scientific literature.
- Modifications of the process (i.e., double-blind and open peer review) have been studied with the goal of improving the quality of reviewers' evaluations and, consequently, that of reports of biomedical studies and of the evidence offered to health care providers, policy makers, and consumers.
- Substantial differences in the quality of reviewers' reports were not observed in the numerous primary and secondary studies conducted on the proposed modifications of the peer review process, as methodological shortcomings and study bias often go undetected independently of the system adopted.
- Independently of theoretical pros and cons, the open system with posting of prepublication histories changes the overall perspective and the goal itself of peer review, as it brings under the spotlights all the editorial activities linked to article publication, overcoming the limits of an excessive focus confined to reviewers' role.
- It seems ethically sound that each step that leads to publication of studies that may imply consequences for patients is rendered transparent.

296 CONFLICT OF INTEREST

297 Paolo Vercellini is associate editor of Human Reproduction Update; Laura Buggio state
298 that she has no conflict of interest to declare; Paola Viganò is associate editor of Human
299 Reproduction and received grant for “Fertility Innovation” by Merck Serono; Edgardo
300 Somigliana is deputy editor of Human Reproduction. The authors report no other
301 competing interests.

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