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AOA Critical Issues

Current State in Scientific Publishing

AOA Critical Issues Symposium

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Abstract: Orthopaedic surgery has a rich history of publication of the science that supports the practice of our specialty, which dates from 1887. Orthopaedic publishing has evolved since that time, expanding from print to online access, with increasing variation in publication models, including open-access journals and article repositories, and methods of information delivery that include video, data archives, and commentary. This symposium provides an overview of the changes and challenges in the publication of orthopaedic science.

The traditional paradigm of how science is disseminated is changing. Some examples are team science, data sharing, and the use of preprint servers. In addition, the proliferation of many new journals, including “predatory” journals, provides authors more choices but also increased complexity in terms of where to publish one’s work.

Team science involves collaborative research with multiple investigators, usually across disciplines or areas of expertise, that often is based on large data sets or databases¹. Team science benefits from a multicenter approach but involves challenges, including funding, coordination, and negotiating authorship. Team science has produced many large-scale high-impact trials in orthopaedic surgery, such as the Spine Patient Outcomes Research Trial (SPORT), which included economists, orthopaedic surgeons, family medicine physicians, and statisticians.

Data sharing occurs when authors upload the raw data on which a study is based to the publishing journal’s archive or

other sites in order to increase transparency and allow others to evaluate the data. The International Committee of Medical Journal Editors (ICMJE) recently established a mandate that requires authors to include a data-sharing statement in manuscripts submitted to ICMJE journals after July 1, 2018². In orthopaedics, some journals have created the opportunity for authors to upload data during the submission process, but to our knowledge, most have not mandated this action³.

Preprint servers, which are online repositories that make scientific manuscripts available to view and cite without prior external review, represent a somewhat controversial innovation in publishing. Some editors view preprint servers as a direct challenge to the peer-review process⁴, which is a mechanism to support dissemination of accurate scientific information that is useful and relevant. These publicly accessible repositories allow authors to upload scientific manuscripts that have not been peer-reviewed.

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A recent editorial from the editors of 4 orthopaedic journals (*The Bone & Joint Journal*, *Clinical Orthopaedics and Related Research*, *The Journal of Bone & Joint Surgery*, and the *Journal of Orthopaedic Research*), citing concerns related to patient safety and publication ethics, stated that these journals would not accept clinical research manuscripts (defined as research involving human subjects or medical records) that were posted to preprint servers prior to submission. Laboratory research that does not involve human subjects was exempted from this policy, and the journals committed to offer fast-track publication for papers with time-sensitive messages to try to offset a major concern of those who do favor preprint servers⁵. Preprint servers are popular: arXiv.org, started in 1991 and based at Cornell University Library, has >1 billion downloads; bioRxiv.org, started in 2013 and based at Cold Spring Harbor Laboratory in New York, has posted nearly 17,000 preprints, most of them in 2018⁶. Use of these online information repositories makes scientific data easily available to lay readers such as patients, caregivers, and the media. While the lack of peer review is generally noted, many preprint publications closely resemble peer-reviewed articles with similar formatting.

The Evolution of Orthopaedic Publications

The orthopaedic field's first publication was the *Transactions of the American Orthopaedic Association*, published in 1889, which contained abstracts from the 1887 and 1888 meetings of the organization⁷. This publication ultimately became *The Journal of Bone & Joint Surgery*. Subspecialty journals were started more recently: *The American Journal of Sports Medicine* was started in 1972, and the *Journal of Shoulder and Elbow Surgery* was started in 1992.

At the inception of orthopaedic publications, print was the sole medium in use. Journal editing and publication were performed on paper, and journals were printed and mailed. This changed with the emerging technologies of computers and the internet in the late 1990s. The ability to access journal articles as part of online repositories began around 2000. The next evolution in orthopaedic publication was the transition to online publication of articles, with the emergence of all-online journals as well as blended models, which incorporate a print edition with expanded offerings online⁸. Many established orthopaedic journals have maintained print versions while making the journal available to subscribers on the internet, with full text available behind online paywalls. The websites of many orthopaedic journals include access to linked videos, surgical information, expanded references and educational material, case reports, and opportunities for reader commentary.

This transition from print to online has expanded the ability of orthopaedic surgeons to access orthopaedic publications on their computer, tablet, or mobile phone. A survey of the members of the American Society for Surgery of the Hand (ASSH), which was performed 1 year after a change to the blended model (ASSH all-member survey data, 2017) demonstrated that 50% of respondents still preferred the

print edition and about 20% never went online to review the additional online articles. A recent study of medical publications showed that journals that offer both print and online options had higher subscription ratings and satisfaction scores among readers than those with only 1 or the other option⁹.

The Evolution of Open-Access Journals

The shift toward online digital content delivery to allow ready availability of research publications was one of the driving forces in the creation of alternative subscription models, where publishers hold both the copyright and control of access to scientific content. Open-access publication, which is freely available to all readers with internet access, is a growing phenomenon in publishing. Open access also is characterized by copyright arrangements that differ from subscription models and by different approaches to covering the costs of publishing. The earliest stages of open-access publishing are thought to have begun in 1995, when publications that were characterized as free electronic scholarly journals were initiated¹⁰. In many open-access models, the authors retain the copyright to the work, and the authors or institutions pay article-processing charges (APCs) after article acceptance and prior to publication. Other open-access journals are supported by societies or other funding models rather than advertising or subscriptions¹¹. In contrast, the subscription model derives funding for publication and printing from individual subscriptions, advertising, and institutional/library access agreements. In general, the copyright on content published in subscription model journals is held by someone other than the author of the work. Commonly, the copyright holders may be the journal itself, the society that owns the journal, or the publisher. Nearly 70% of traditional journals are published in 4 countries: the United States, United Kingdom, the Netherlands, and Germany¹². Government funding agencies have mandated publication of research funded by their institutes in many countries.

There are subtypes of open-access publications, including gold open access and green open access. Gold open-access publications are freely available for all immediately after publication, and the author retains the copyright to his or her work. Green open access refers to open access after a period of delay or embargo; following that period, which may be several months or a year, the content is archived and made freely available in a repository. One of the most well-known repositories is PubMed Central (PMC), which is free for anyone to use and provides full-text access to what one might call green open-access content; it is important to note that the presence of an article on PMC does not imply that its copyright is held by the author as is the case for gold open-access publications. Some journals are not managed under a comprehensive open-access model, but rather under what is known as hybrid open access, in which the authors or their institutions can pay a traditional journal an APC to publish their work as open access, even when the remainder of the journal is published behind a

TABLE I Common Forms of Scientific Misconduct

Unethical research conduct
Animal care, coercion of patients/unfair consent, fabricated data, etc.
Reviewer appropriates authors' ideas
Plagiarism
Duplicate or redundant publication
Undisclosed conflict of interest (COI)
Retaliation against whistleblowers, defamation, and social media "trolling"
Ghost, gift, or otherwise inappropriate authorship
Methods recycling

subscription paywall¹³. These uploads are subject to the publishing journal's rules about self-archiving, including what version of a publication can be uploaded, and about copyright, held either by the authors or the publication¹³. Some journals upload full-text versions of their articles to PMC after a 1-year embargo, which allows the authors to meet the requirements of funding agencies who require that work that they supported be made freely available after a period of time (such as the National Institutes of Health [NIH], which requires open access to publications derived from NIH funding)¹⁴.

Some authors' choice of journal for submission of their manuscript is thought to be based on visibility, cost, prestige, and speed to publication¹⁵. There is increasing evidence of higher downloads and higher citation rates from open-access journals compared with subscription journals¹⁶. When considering journal prestige, this can be measured by impact factor (IF) (calculated as the number of times that articles that were published in a 2-year period were cited, divided by the total number of citable items—sources that include articles but exclude items such as editorials and commentaries—in that journal during that time) and reputation, and the open-access world is rapidly gaining in these metrics. A recent study by Björk and Solomon evaluated the 2-year IF in >7,000 journals, and showed that the IF of open-access journals was approximately 70% of the IF of traditional journals¹². The quality of open-access articles is sometimes questioned because of the lower IF in less-established open-access journals¹². However, open-access journals such as *BMC Biology*, *PLOS ONE*, and *Cell Reports* have highly competitive IFs. Finally, timing of publication can be critical in a very competitive research environment. Solomon's recent survey of authors choosing large open-access journals noted that speed to publication was a consistent high priority with this choice¹⁷.

The costs related to where one publishes are also a factor in the choice of where to submit. On the institutional level, where funds for library costs are being cut, the open-access model is favored because of the shift away from subscription fees. However, it is important to note that this shifts the cost of open-access publication to authors or departments that also struggle with limited funding.

In orthopaedic surgery, Sabharwal et al. noted minimal penetration by open access, with only 5 of 63 (8%) orthopaedic journals published as full open access¹⁸. However, 20 of 63 journals (31.7%) had hybrid-model publishing, which allowed open access if the author paid APCs. There is a rapidly changing landscape in publishing, with many journal options available for submission, and our specialty is likely to see changes in both traditional and open-access models.

One other consideration in where to publish is the growing number of predatory open-access journals, defined as journals that do not meet standards of publication, including peer review, indexing, archiving, defined copyright, and editorial board participation, but rather exist primarily for profit based on charging APCs¹⁹. It is recommended that authors investigate potential journals for submission by confirming that these standards exist and checking whether the journal is listed in the Directory of Open Access Journals (DOAJ), which has stringent standards for inclusion¹⁹. One other tool for authors is a website that was created for the purpose of helping to identify predatory journals: <https://thinkchecksubmit.org>.

Ethical Challenges in Publishing

While all clinicians and scientists would like to believe that individuals who perform clinical and laboratory research conduct their work with integrity, evidence suggests that this is not always the case. Two meta-analyses estimated that nearly 2% of scientists admitted to having fabricated, falsified, or modified data or results at least once^{20,21}. One-third of those surveyed said that they had either observed a colleague commit plagiarism²¹ or had themselves engaged in questionable research practices such as p-value hunting, selective reporting, or concealing conflicts of interest²⁰ (Table I). Mulligan et al. reported a large international survey of 4,037 researchers, noting that the majority did not have confidence in the current peer-review system's effectiveness in detecting fraud²².

Retraction of orthopaedic papers after publication seems to be happening more often²³. One watchdog website found

TABLE II Tools for Reviewers, Editors, and Publishers When Misconduct Is Suspected

Committee on Publication Ethics (COPE, www.publicationethics.org)
Checklists
Website/database of cases
Webinars, free consults for members
International Committee of Medical Journal Editors (ICMJE, www.icmje.org)
Authorship standards
Clear journal standards presented transparently on journal websites
iThenticate/CrossCheck (https://www.ithenticate.com)
Sensitivity and compassion on the part of all involved

that the 10 most-retracted authors across all disciplines have between several dozen and nearly 200 retracted papers each; more than half of these authors have published in biomedical journals²⁴. A reviewer-fraud ring involving international identity theft²⁵ resulted in hundreds of retracted articles²⁴, including dozens in orthopaedic journals²⁵. These data suggest a growing need for vigilance on the part of reviewers, editors, and publishers of biomedical journals. While scientific misconduct can

vary from the obvious to much more subtle (Table I), the harm is unambiguous: clinicians depend on what they read in peer-reviewed biomedical journals, and when that content lacks integrity, patients may be impacted^{26,27}.

Fortunately, those involved with peer review can make use of freely available tools that can help (Table II). The Committee on Publication Ethics (COPE, www.publicationethics.org) publishes flowcharts that editors and reviewers can use

What to do if you suspect plagiarism

(a) Suspected plagiarism in a submitted manuscript

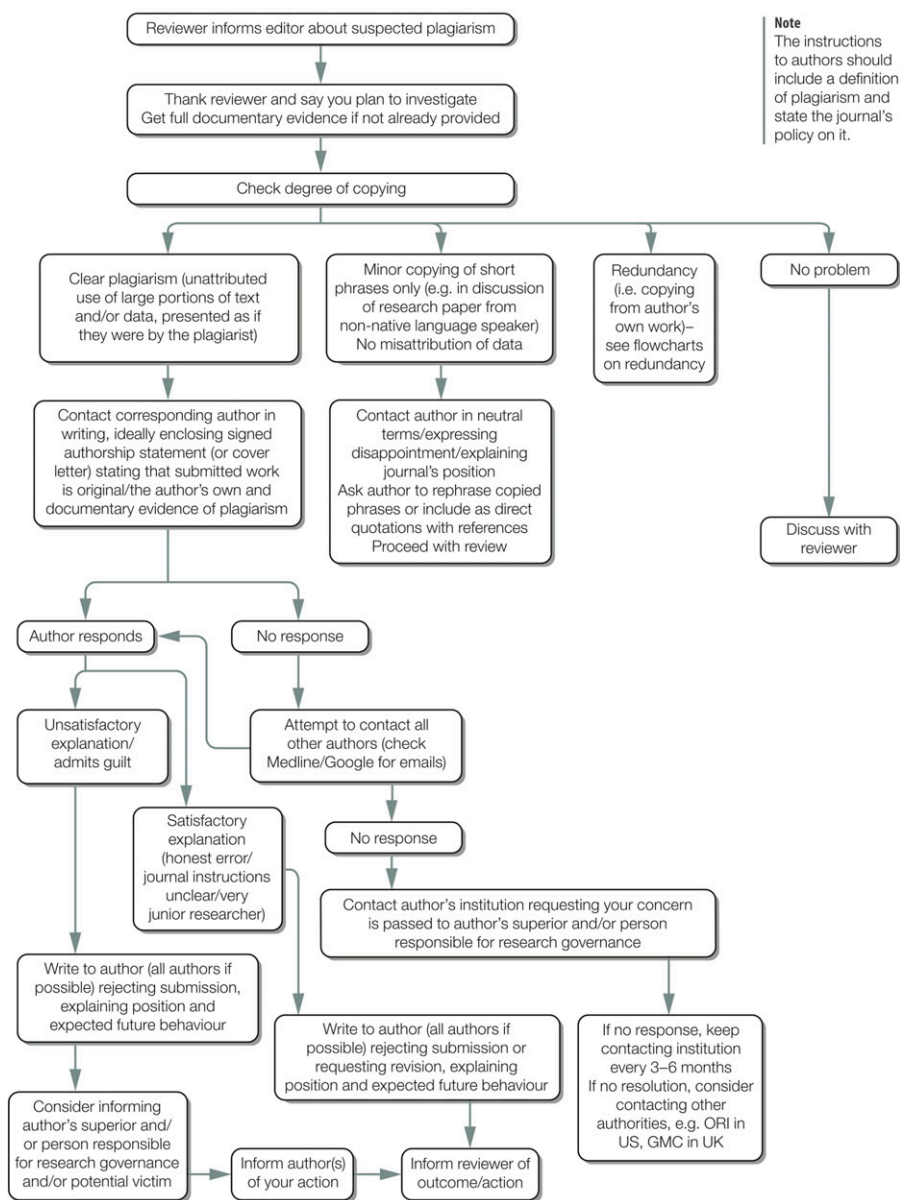


Fig. 1

Flowchart of action when plagiarism is suspected. ORI = Office of Research Integrity and GMC = General Medical Council. (From the Committee on Publication Ethics [COPE]. What to do if you suspect plagiarism: <https://publicationethics.org/>.)

when they suspect that research misconduct has occurred. Although some journals recommend sanctioning authors who have committed misconduct, COPE does not endorse sanctions; most of their flowcharts end with contacting the authors' institutions or national bodies such as the Office of Research Integrity in the United States (<https://ori.hhs.gov>) or the General Medical Council in the United Kingdom (<https://www.gmc-uk.org>) if the author's institution is unresponsive (Fig. 1).

The ICMJE (www.icmje.org) provides helpful guidance on issues of authorship, clinical trial registration, and other topics pertaining to the conduct and reporting of scientific research. While no orthopaedic journals are members of the ICMJE (it is a closed working group of general medical journal editors), many orthopaedic journals state that they adhere to the ICMJE's recommendations². *The Journal of Bone & Joint Surgery*, *The Bone & Joint Journal*, and *Clinical Orthopaedics and Related Research* recently collaborated on a set of shared standards for prospective registration of randomized trials²⁸, which has been an ICMJE priority. Many journals now use a commercial tool called CrossCheck (iThenticate CrossCheck; Turnitin), which identifies when text in a submitted manuscript has appeared in an earlier published source; articles that duplicate the work of others can be identified by the editors, who will query the authors if the pattern of duplication is concerning.

While few question whether plagiarism (defined by COPE as "unattributed use of large portions of text and/or data, presented as if they were by the plagiarist") (Fig. 1) is a form of scientific misconduct, there is considerable blurring of normative standards where the reuse of one's own work is concerned, which is sometimes called text recycling (or, most frequently, methods recycling)²⁹. After all, there are only so many ways to write that a t test was performed and significance was set at $p < 0.05$; however, the topic grows more complex when whole pages of methods text are duplicated from one's own published copyrighted sources, or when an author reproduces verbatim paragraphs from the discussion section of an earlier publication. Different journals apply different standards; the view of many editors in orthopaedics is that this practice of reuse is inappropriate²².

Finally, it is important to realize that cultures around the world differ, and differences in human values are reflected in the research that individuals conduct and report in scientific journals. Western cultures may place a higher value on individualism, while Asian countries are more likely to prioritize the collective³⁰. These differences may reflect what some in the West perceive to be more-flexible notions of intellectual property among their Asian colleagues³¹. Since some Asian countries now heavily incentivize researchers to publish in Western journals, one side or the other needs to yield. There is evidence that in China, the government is seeking to move its scientists in the direction of embracing Western norms of scientific reporting³² and academic integrity³³. Editors need to apply sensitivity and understanding in light of cultural differences and institutional pressures that vary internationally.

Innovations in Scientific Reporting

In some ways, scientific reporting has changed little in the last several centuries. Certainly, its most important, main goal, communication of discoveries that can improve or extend life (or to bring "some satisfaction to sick mens [sic] minds," as articulated by the publisher of the first English-language medical journal³⁴) has not changed at all. However, the means through which we achieve this goal have—and continue—to improve.

While English-speaking scientists have disseminated medical discoveries in print for nearly 350 years, peer review as we now conceive of it is much newer. The *Journal of the American Medical Association (JAMA)* did not use outside reviewers until 1940; *Nature* did so in 1973, and *The Lancet* first engaged external referees in 1976³⁵. While peer review has issues of susceptibility to fraud²⁵, bias-favoring research showing "positive" results³⁶ (although evidence is mixed, as shown in the evaluation of research published in *JBJS*³⁷), or well-known authors (with single-blind or unblinded review)³⁸, as well as prejudice against women both at the level of reviewer invitation³⁹ and assessment of the work itself⁴⁰, most believe that peer review increases the quality and maintains the integrity of the published work. Even so, considerable work remains in order to make peer review fairer.

Peer review is further hampered by the fact that it is performed by volunteers who may not have had any special training in the task. The quality of reviews can be variable, and educational programs seem to have little effect on the effectiveness of peer review⁴¹. Systems-level innovations, rather than one-off teaching courses, may hold more promise.

With the goal of making the process more fair, efficient, and effective, *Clinical Orthopaedics and Related Research* created an online application (<http://tools.clinorthop.org/reviewertool>) to help reviewers to focus their attention when reviewing orthopaedic research of all kinds, including studies of treatments, diagnostic tests, the natural history of disease, and systematic reviews/meta-analyses. It points the reviewers to questions that apply to all manuscripts (Is the work novel? Important? Generalizable?) as well as those that apply to each different article type. This tool is freely available and produces printable output that reviewers can use when sending their comments to any journal; it also can help trainees become more thoughtful readers⁴². Initial findings (unpublished) suggest that the tool decreases reviewers' turnaround time by >60% and helps newer reviewers provide more content-rich reviews. *JBJS* also has a Reviewer Resource Center that provides guidance to reviewers (<https://journals.lww.com/jbjsjournal/Pages/Reviewer-Resources.aspx>).

Summary

The orthopaedic publishing landscape is changing, and there are many options for authors to disseminate their findings. Orthopaedic surgeons and scientists are challenged to choose how and where to present innovation and new data, and the choices are expanding. The forces of preprint servers, online publication ahead of print, data repositories, and open access are part of the evolution in publishing.

As publications evolve, it is critical to maintain normative standards of external evaluation and integrity. Orthopaedic

journals are innovating to assist authors and reviewers to improve efficiency and quality. ■

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