

Teaching Authorship and Publication Practices in the Biomedical and Life Sciences

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Abstract Examination of a limited number of publisher's Instructions for Authors, guidelines from two scientific societies, and the widely accepted policy document of the International Committee of Medical Journal Editors (ICMJE) provided useful information on authorship practices. Three of five journals examined (*Nature*, *Science*, and the *Proceedings of the National Academy of Sciences*) publish papers across a variety of disciplines. One is broadly focused on topics in medical research (*New England Journal of Medicine*) and one publishes research reports in a single discipline (*Journal of Bacteriology*). Similar elements of publication policy and accepted practices were found across the policies of these journals articulated in their Instructions for Authors. A number of these same elements were found in the professional society guidelines of the Society for Neuroscience and the American Chemical Society, as well as the ICMJE Uniform Requirements for Manuscripts Submitted to Biomedical Journals. Taken together, these sources provide the basis for articulating best practices in authorship in scientific research. Emerging from this material is a definition of authorship, as well as policy statements on duplicative publication, conflict of interest disclosure, electronic access, data sharing, digital image integrity, and research requiring subjects' protection, including prior registration of clinical trials. These common elements provide a foundation for teaching about scientific authorship and publication practices across biomedical and life sciences disciplines.

Keywords Authorship criteria · Instructions for authors · Publication guidelines · Publication best practices · ICMJE · American Chemical Society · Society for Neuroscience · *Science* · *Nature* · *Proceedings of the National Academy of Sciences* · *Journal of Bacteriology* · *New England Journal of Medicine*

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Introduction

Beginning in 1989, US federal mandates for instruction in responsible conduct of research (RCR) have emphasized the importance of teaching about authorship in science (National Institutes of Health 1989,1992). These mandates originally were issued by the US Department of Health and Human Services through the National Institutes of Health (NIH). Given the health-related mission of NIH research funding activities, RCR curricula in authorship typically became aligned with biomedical and life sciences. This is aptly illustrated in texts and monographs designed for use in RCR courses (Barnbaum and Byron 2001; Bulger et al. 2002; Macrina 2005; Shamoo and Resnik 2009; Steneck 2004). The content of these materials emphasizes standards that have grown from the authorship and publication culture of biomedical and life science research. Further, guidelines and standards for publication from scientific societies (American Chemical Society 2010; Society for Neuroscience 2010), medical journal editor organizations (International Committee of Medical Journal Editors 2010) and agencies such as the NIH (National Institutes of Health 2007) also contain appropriate content for RCR instruction.

The scope and amount of material on authorship available for RCR education has grown significantly in the past three decades. This material has been augmented by primary publications and review articles on authorship that have helped to further identify and define related issues (Claxton 2005; Scheetz 2001). As evident in the companion papers on authorship in this volume of *Science and Engineering Ethics*, standards, policies, and norms of authorship also extend into research disciplines beyond the biomedical and life sciences (Bebeau and Monson 2011; Borenstein 2011; Plemmons 2011). There are similarities and even convergences in the practices of authorship spanning a diversity of disciplines including engineering and social and behavioral sciences, along with the biomedical sciences. The foundational elements of authorship that have grown from the general arena of biomedical and life sciences research provide a context for policies and trends on authorship in disciplines like behavioral and social sciences and engineering. Such an expanded appreciation will augment teaching content and promote further dialogue as an increasing number of trainees from disciplines other than the biomedical and life sciences seek RCR instruction.

The Genesis of Authorship Policy and Practices

Three principal sources of guidance and policy on scientific authorship are: (1) publishers, (2) scientific societies, and (3) editorial associations and committees. Publishers provide guidance in the form of Instructions for Authors (IFA) and journal publication policies. Instructions for Authors and formal publication policies are often linked to one another covering similar topics in varying degrees of detail. Several scientific societies have published freestanding guidelines for authorship. Other societies that sponsor their own journals also do this through IFA and related publication policies. Finally, over the past several decades, editorial associations or committees have also been active in promoting publication policies. Taken together,

the policies and guidelines from these various sources provide a framework of normative behavior that is useful in teaching about responsible scientific authorship.

Instructions for Authors and Publication Policies

To illustrate the extent to which such documents provide information about authorship and publication practices, five journals in the life and biomedical sciences were selected and their IFAs and publication (or editorial) policies were examined. The journals selected are published by scholarly societies or organizations; one is published by a for-profit company. They are: (1) *Science* (published by the American Association for the Advancement of Science); (2) *Nature* (published by the Nature Publishing Group, a division of Macmillan Publishers, London); (3) *Journal of Bacteriology* (published by the American Society for Microbiology); (4) *Proceedings of the National Academy of Sciences –USA* (published by the National Academy of Sciences); and, (5) the *New England Journal of Medicine* (published by the Massachusetts Medical Society). Based on the material presented in these documents, a list of common topic areas was compiled, and an overview of these findings follows.

Definition of Authorship

All of the journals provided either a definition of authorship, referred to an existing definition (e.g., the International Committee of Medical Journal Editors (ICMJE) definition [see below]), or discussed authorship responsibilities. The *Journal of Bacteriology* [*JB*] (American Society for Microbiology 2010) and the *Proceedings of the National Academy of Sciences* [*PNAS*] (National Academy of Sciences 2011) define an author as someone who has contributed substantially to the work, with *JB* clarifying that this must be a contribution to the overall design and execution of the experiments. *JB* considers all co-authors responsible for the entire paper, and it does not require authors to indicate their specific contributions to the work. On the other hand, the *PNAS* IFA states that authors who have made specific contributions to the work are responsible for those components of the paper, but have only limited responsibility for other results in the paper. However, the *PNAS* IFA requires that at least one author have responsibility for the accuracy and integrity of the entire paper. The IFA allows this responsibility to be shared by more than one author, if appropriate. This model is often referred to as guarantorship. Further, *PNAS* requires that all authors indicate their specific contributions to the work. This information, published as a footnote, is commonly called the contributorship model. *Science* (American Association for the Advancement of Science 2010) and *Nature* (Macmillan Publishers, Ltd, Nature Publishing Group 2009) discuss authorship responsibilities across a range of activities from seeking co-author approval of the manuscript to requiring at least one person to assume responsibility for custody, sharing, and reproducibility of the data. Both the *Science* and *Nature* IFA require that all authors describe their contributions to the work. *Nature* uses a variation on the guarantorship model in which each collaborative team on the author's byline have a senior member accept the responsibility for the contributions of the team.

The *New England Journal of Medicine* [NEJM] (Massachusetts Medical Society 2011a) requires that all co-authors meet the authorship definition of the ICMJE (Uniform Requirements for Manuscripts Submitted to Biomedical Journals 2010). This definition is presented and discussed below.

All five of the journals' IFAs contain language that requires co-authors' approval of the manuscript and their agreement with its submission. This agreement is typically documented by the affirmation (signature) of the author who ultimately submits the manuscript for publication; this person is referred to variously as the contributing or submitting author. Similarly, any change in authorship must be agreed to by all of the original co-authors.

Duplicate Submission and Previous Publication

All five journals prohibit the submission of material that has been previously published. Similarly, manuscripts may not be concurrently submitted for publication in any other journal. In the case of the *NEJM*, its policy is derived from its accord with the ICMJE Uniform Requirements for Manuscripts Submitted to Biomedical Journals. *JB*'s IFA lists what constitutes prior publication including a serial, periodical, or book, a conference report or symposium proceeding, a technical bulletin or company white paper, a non-personal website, or any other retrievable source. There are notable exceptions to this policy, and both *JB* and *Nature* state that they accept for consideration manuscripts that contain material from theses or dissertations which have been published as a requirement of the degree-awarding institution. *PNAS* provides clarification that previously published tables or figures can be identified and published if permission is sought and obtained from the copyright holder for both the print and online versions of the material. *Nature*'s IFA makes a similar statement.

Nature allows the publication of material on recognized community preprint servers that allow review by other scientists prior to submission to the journal. At the time of submission to *Nature*, details of the preprint server need to be provided to the editors. This policy does not apply to preprints that are made available to the media or otherwise publicized beyond the scientific community.

Prepublicity or Public Disclosure Prior to Publication

The IFAs for *Nature*, *Science*, *PNAS*, and *NEJM* contain embargo policies. In general, these policies require that there be no discussion about the reported research results with the media prior to the publication date or a deadline that is usually within a day to several days of the publication date. There are variances in these policies that include approval of presentation and discussion of the work at meetings with or without notifying the publisher (but no specific discussion with the press) and release of papers to the press up to a week prior to publication. *JB* does not include an embargo policy in its IFA. However, the American Society for Microbiology communicates to authors at the time of acceptance that public disclosure of the manuscript should not occur until the "ahead of print" version of the paper appears on the journal's web site. (personal communication, Dr. Barbara

Goldman, Director of Journals, American Society for Microbiology). *NEJM* releases prepublication copies to journalists several days before publication under the condition that they not publish a story on the research until 5pm on the day prior to the publication date. *NEJM* provides two fundamental reasons for embargo: "...it gives the media time to report accurately on complex and important new research findings, and it allows subscribers to read and understand the full reports in the Journal before media reports prompt patients to call with questions" (Massachusetts Medical Society 2011b).

Conflict of Interest Disclosure

Disclosure of situations that might pose a conflict of interest (COI) regarding the submitted manuscript is required by all five of the journals. All of these journals have explicit language about COI in their IFAs with some referring to an extended description of COI issues found in related publication policies. Some of the journals require the completion of a disclosure form at the time the manuscript is submitted. Background on potential COI situations is presented in varying detail throughout the IFAs. *JB* provides specific examples requiring disclosure including commercial affiliations, consultancies, stock or equity interests, patents, and licensing arrangements. Further, the *JB* IFA indicates that "inclusion of a company name in the author address lines of the manuscript does not constitute disclosure." *JB* requires that authors disclose all funding sources for the project in the Acknowledgements section of the paper. Also required is the manufacturer's name of any commercial product that is the subject of the reported research. *Nature's* IFA categorizes potential COI situations (called competing interests) into three categories: funding, employment, and personal financial interests. Specific examples are provided for each of these categories.

Both *Nature* and *PNAS* affirm that competing interests disclosure and policy adherence is extended to all members of the publication process including authors, referees, and editors. This is also true for *NEJM* by virtue of similar language in the ICMJE Uniform Requirements for Manuscripts Submitted to Biomedical Journals (see below).

Copyright

JB and *NEJM* require that authors sign a copyright transfer agreement assigning the associated intellectual property rights to the respective publisher. In practical terms, a copyright affords the owner the right to use, reproduce, transmit, publish, and distribute the article. This means that authors may not use or authorize the use of their published material without the permission of the copyright owner. Typically copyright is assigned to the publisher by the submitting author on behalf of all the co-authors. *JB* allows authors to post articles they have written on their personal or university hosted web site; posting on corporate or government web sites is not allowed.

Although this copyright assignment policy is widespread in the biomedical publishing community, within the past several years *Nature*, *Science* and *PNAS*

have amended their policies. All three journals now allow authors to retain copyright, but grant the respective publishers an exclusive license to publish the paper in print and online. Allowing authors to retain copyright on their published works typically allows them to post PDFs on personal or institutional web sites (unless they are corporate sites), and to make copies for personal use and for teaching purposes. It may also allow authors to use all or part of their works in other materials prepared by the authors; e.g., syllabus material, theses and dissertations, and new or modified writings.

Access Policies

Affording copyright retention to authors has allowed broad electronic access to papers published in *Science*, *Nature*, and *PNAS*. In 2008, the NIH implemented a mandatory public access policy for published research supported by that agency. This policy requires that, upon acceptance, all peer-reviewed manuscripts be deposited to the digital archive of biomedical and life sciences journals, PubMed Central (National Institutes of Health 2010). Further, papers deposited in PubMed Central must be accessible to the public no later than 12 months after publication. This policy was guided by the thinking that freely accessible, published NIH-funded research will help advance science and ultimately improve human health. All five of the journals mentioned in this paper are affected by this policy. This public access policy allows the copyright to be held by the original owner (i.e., publisher or author depending on the journal). *JB* and *PNAS* automatically deposit accepted manuscripts in PubMed Central, as a service to the author. In addition, all papers from each of these journals are deposited with PubMed Central, regardless of funding source. *Nature* allows authors to opt-into the journal's manuscript deposition service, or authors may deposit their accepted manuscripts independently. *Science* allows authors to deposit their accepted manuscripts in PubMed Central and requires that a link to the paper found on the *Science* web site be included. In addition, all research papers published in *Science* are freely accessible on the publisher's web site 12 months after the publication date. *NEJM* allows authors to post required manuscripts to PubMed Central in compliance with the NIH mandate.

Data Sharing and Deposition

Science, *Nature*, *JB*, and *PNAS* IFAs all include language that speaks to the obligation of the authors to share their data upon request and to deposit archival data in publicly available databases. The language and level of detail vary from journal to journal but the message is uniform. *Science*'s IFA states that "all reasonable requests for materials must be fulfilled". They also request that any restrictions on sharing of materials be disclosed to the editor before acceptance, e.g., the necessity of a Material Transfer Agreement to share materials. *Nature* asserts as a condition of publication that authors: "...make materials, data, and associated protocols promptly available to others without precondition". *JB* requires that authors make materials available in a timely fashion and for reasonable cost, in limited quantities to members of the scientific community for noncommercial purposes. The

requirements of the *PNAS* IFA are similar to those found in *Science*. Deposition of archival data in public databases as a condition for publication is discussed in varying detail in each of these four journals. Examples include protein and nucleic acid sequences, and structural determination data including x-ray crystallographic data and nuclear magnetic resonance data. The *NEJM* IFA addresses data sharing expectations in terms of one specific aspect: studies involving microarray analysis must be accompanied by the location of the public repository containing those data as well as an accession number.

Protection of Human Subjects

All five of these journals require assurance that the use of research subjects—human or animal—has been in compliance with relevant laws, policies and guidelines. The specificity of required assurance language varies among these journals, but confirmation of the human subjects' informed consent typically is requested.

Digital Image Integrity

All five of the journals' IFAs address the issue of digital image manipulation. The scope and complexity of the language about this varies. At one end of the spectrum is *NEJM*'s simple request that any adjustments or enhancements to digital images be described and clearly indicated. In contrast, *Nature* has a one-thousand-word policy that prescribes the limits of any processing of electrophoretic gels, blots, or micrographs. IFAs in the other journals mention issues such as processing must be minimal, the original data must be retained, and any adjustments must be disclosed. Selective manipulations or enhancements to images are not considered appropriate.

Biosecurity

Concerns about the publication of research results that may have implications for biosecurity are addressed in the IFA or publication policies of all of the journals except *NEJM*. The term biosecurity falls under umbrella phrases like Dual Use Technology, or Dual Use of Concern and implies knowledge in the biological, life science, or medical fields that could be used both for good or for evil purposes. The *JB* IFA contains the most detail in this regard beginning with an articulation of the American Society for Microbiology's position that its members: "...will work for the proper and beneficent application of science and will call to the attention of the public or the appropriate authorities misuses of microbiology or of information derived from microbiology." It further affirms that ASM members are: "...obligated to discourage any use of microbiology contrary to the welfare of humankind, including the use of microbes as biological weapons." *PNAS* terms this issue Dual Use of Concern and requires authors and reviewers to notify the editor-in-chief if a manuscript contains material that falls into this category. Such notification will prompt evaluation by the editor-in-chief, who may seek the opinions of additional expert reviewers. The IFA in *Science* invokes dual use terminology, requiring that concerns of authors and reviewers be transmitted to the editor-in-chief, who may

seek further outside evaluation from reviewers with appropriate expertise. *Nature's* IFA contains a policy on biosecurity implications that is similar to *PNAS*, but it is described in more detail.

Clinical Trial Registration

As a journal subscribing to the ICMJE Uniform Requirements for Manuscripts Submitted to Biomedical Journals (International Committee of Medical Journal Editors 2010), *NEJM* requires registration of all clinical trials. This policy was created by the ICMJE in response to some highly publicized cases of incomplete reporting of clinical trial data that, in retrospect, proved critical to the understanding of the performance and side effects of the drugs being tested. In the case of *NEJM*, registration of a clinical trial must occur on a publicly accessible database that meets the requirements of the ICMJE (e.g., www.clinicaltrials.gov). The rationale is that full disclosure of a clinical trial will afford the editor and editorial reviewers an opportunity to compare the manuscript to the full scope of the trial and, if needed, pose questions about congruence of the trial and the content of the submitted manuscript. The *PNAS* IFA also requires that clinical trials be registered in accordance with the ICMJE guidelines.

Scientific Society Guidelines

Some scientific societies have developed guidelines that provide a strong foundation in establishing and affirming normative behavior in the reporting of research results. These documents are useful in the teaching of authorship and publication practices in RCR courses. They are usually extensive and detailed, providing considerably more depth than that seen in IFAs (for societies that publish their own journals, these guidelines are usually linked to the IFAs). Two examples of publication guidelines are the Society for Neuroscience's (SFN) *Responsible Conduct Regarding Scientific Communication* (Society for Neuroscience 2010) and the American Chemical Society's (ACS) *Ethical Guidelines to Publication of Chemical Research* (American Chemical Society 2010). The ACS *Guidelines* have been in place for approximately two decades and have been revised over time. They served as a model for the SFN committee that developed their guidelines, resulting in similarities in content between the two documents. A striking difference, however, is the length of the two documents. Downloaded as PDF files, the ACS document is five pages while the SFN document is twenty pages. The ACS document is divided into sections that deal with the ethical obligations of: (1) scientific journal editors, (2) authors, (3) manuscript reviewers, and (4) scientists publishing outside the scientific literature. The SFN guidelines cover these same topics. Additionally, they address abstracts for presentations at scientific meetings and dealing with possible scientific misconduct. Both of these documents contain many of the elements found in the IFAs reviewed above including sharing of research materials, confidentiality of the review process, and conflict of interest disclosure and management. These documents also provide guidance statements not typically found in other IFAs, such as urging of submission of manuscripts to peer-reviewed journals, avoiding

publishing fragmented reports, being responsible in citing the research literature, and striving for clarity of writing, accuracy, and level of detail.

These documents both provide detailed discussions of the definition and responsibilities of authorship. The ACS document states that:

The co-authors of a paper should be all those persons who have made significant scientific contributions to the work reported and who share responsibility and accountability for the results. Other contributions should be indicated in a footnote or an “Acknowledgments” section. An administrative relationship to the investigation does not of itself qualify a person for co-authorship (but occasionally it may be appropriate to acknowledge major administrative assistance). Deceased persons who meet the criterion for inclusion as co-authors should be so included, with a footnote reporting date of death. No fictitious name should be listed as an author or co-author. The author who submits a manuscript for publication accepts the responsibility of having included as co-authors all persons appropriate and none inappropriate. The submitting author should have sent each living co-author a draft copy of the manuscript and have obtained the co-author’s assent to co-authorship of it.

The SFN Guidelines contains a section titled: *Authorship should be based on a substantial intellectual contribution*. Its preamble reads:

It is assumed that all authors have had a significant role in the creation of a scientific communication that bears their names. Therefore, the list of authors on an article serves multiple purposes; it indicates who is responsible for the work and to whom questions regarding the work should be addressed. Moreover, the credit implied by authorship is often used as a measure of scientists’ productivity in evaluating them for employment, promotions, grants, and prizes.

The SFN Guidelines state that the Society subscribes to the definition of authorship published by the ICMJE (See below). The SFN Guidelines specifically mention “ghostwriting” and “honorary authorship” as being unacceptable practices. The former refers to a manuscript that is written by someone who is listed neither on the author byline nor in the acknowledgements. The latter refers to someone who is listed as an author but has not made a significant intellectual contribution to the work described in the paper.

Editorial Associations and Committees

A number of organizations, described variously as committees, associations, or councils have contributed much to the genesis and dissemination of norms and values of authorship. These groups typically are not open-membership organizations and are comprised of professionals in the publishing field who think and write about many aspects of scientific publication. Arguably, the organization that has had the highest impact on publication standards is the ICMJE which created uniform requirements for authorship in 1978. These guidelines have been regularly updated,

most recently in April 2010 (International Committee of Medical Journals Editors 2010). The argument for the acceptance and impact of the ICMJE Uniform Requirements resides in the adoption (in whole or in part) by several hundred biomedical journals. For example, in the US the ICMJE's Uniform Requirements have been adopted by journals published by the American Medical Association, the American Dental Association, and the Massachusetts Medical Society (see previous discussion concerning the *NEJM*). The core of the ICMJE definition of authorship is:

Authorship credit should be based on 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published. Authors should meet conditions 1, 2, and 3.

Other elements have been added to this definition in recent years. With regard to publications involving extensive engagement of researchers, the following applies.

When a large, multicenter group has conducted the work, the group should identify the individuals who accept direct responsibility for the manuscript. These individuals should fully meet the criteria for authorship/contributorship defined above, and editors will ask these individuals to complete journal-specific author and conflict-of-interest disclosure forms. When submitting a manuscript authored by a group, the corresponding author should clearly indicate the preferred citation and identify all individual authors as well as the group name. Journals generally list other members of the group in the Acknowledgments. The NLM [National Library of Medicine] indexes the group name and the names of individuals the group has identified as being directly responsible for the manuscript; it also lists the names of collaborators if they are listed in Acknowledgments.

Other details connected to the ICMJE's definition of authorship include:

Acquisition of funding, collection of data, or general supervision of the research group alone does not constitute authorship.

All persons designated as authors should qualify for authorship, and all those who qualify should be listed.

Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content.

The scope and content of the ICMJE Uniform Requirements and the associated material on the ICMJE website forms a useful syllabus for teaching the topic of authorship and publication in RCR courses. Regular updating of the ICMJE Uniform Requirements adds value to this document as a teaching resource. In the past several years, updates to the Uniform Requirements have included the requirement of clinical trial registration (see above) and the creation of an electronic conflict of interest reporting form that assists editors in identifying potential competing interest issues. The form has been placed in the public domain on the ICMJE website and other scientific journals are being urged to adopt and use the form.

Another organization in this genre is the Council of Science Editors [CSE] (Council of Science Editors 2011). This group began in 1957 as the Council of Biology Editors. Its mission is: “to serve editorial professionals in the sciences by creating a supportive network for career development, providing educational opportunities, and developing resources for identifying and implementing high-quality editorial practices.” The CSE also has a useful website in terms of potential teaching materials. Of note is a recent publication by the CSE titled *White Paper on Promoting Integrity in Scientific Journal Publications* (Council of Science Editors 2009). This document was initially published in 2006 and was revised in 2009. The topics discussed in this document on authorship are similar to those seen in some scientific society guidelines (e.g., ACS and SFN) and there is congruence of substance of the White Paper with the norms and practices covered in the various other sources discussed in this paper. The Council points out that the White Paper is a document aimed at promoting dialogue about publishing practices, especially among professional organizations to help shape the “scientific journal environment”. Apropos of the series of papers in this issue of *Science and Engineering Ethics*, the Council states:

We intend to work with other professional organizations to shape the scientific journal environment so the integrity of our publications is upheld. With the understanding that what may be appropriate for one discipline or organization may not be so for another, the White Paper intends to inform and guide rather than direct. Where there is more published information available from the biomedical community on some of the topics in this paper, more references or examples in those areas are given. However, our intention is to provide information that is useful to all the sciences (Council of Science Editors 2009, p.7 of White Paper PDF)

Topics covered in the White Paper include: editors’ roles and responsibilities; authorship; reviewers’ roles and responsibilities; sponsors’ roles and responsibilities; relations between editors and publishers; sponsoring societies, or journal owners; responsibilities to the media; description of research misconduct; international models for responding to research misconduct; reporting suspect manuscripts; digital images and misconduct; correcting the literature; and handling third-party inquiries about scientific misconduct.

Finally, two other organizations should be noted in this discussion. The World Association of Medical Editors (2011) was established in 1995 to facilitate worldwide cooperation and communication among editors of peer-reviewed journals. This group compiles resources and develops policies of relevance to authorship and publication practices. The Committee on Publication Ethics (2010) formed in 1997, is a forum for editors of peer-reviewed journals: “... to discuss issues related to the integrity of the scientific record; it supports and encourages editors to report, catalogue and instigate investigations into ethical problems in the publication process.” The online resources of both of these organizations reflect many of the elements of publication process and responsibility discussed in this paper making them additional references for both scientific practice and training in authorship and publication practices.

Conclusion

This paper presents a variety of sources that provide authoritative information on authorship standards and publication practices. Much of this material has originated and evolved over the past three decades. For example, the 1975 versions of the IFAs found in the five journals examined here did not yield much in the way of standards that apply to publication practices. Most of what constituted these IFAs in the mid-1970s was concerned with the logistics of manuscript preparation and submission. The IFAs of *JB* (American Society for Microbiology 1975), *Science* (American Association for the Advancement of Science 1975), the *NEJM* (Massachusetts Medical Society 1975), *Nature* (Macmillan Journals, Ltd. 1975) and *PNAS* (National Academy of Sciences 1975) included language that referred to the inappropriateness of submitting previously published material and of simultaneous submission. Only *JB* (American Society for Microbiology 1975) affirmed copyright transfer to the publisher, while the *NEJM* (Massachusetts Medical Society 1975) mentioned the requirement of providing written permission to use previously copyrighted material. The *PNAS* IFA (National Academy of Sciences 1975) required confirmation of human subjects' research authorization. The present day IFAs described in this paper reveal a dramatic qualitative and quantitative expansion in their guidance and requirements. Substantive authorship guidelines from scientific societies like the American Chemical Society and the Society for Neuroscience have appeared in the past two decades. Their contents in general have revealed standards similar to those found in the journal IFAs examined here. Taken together, the IFAs and the SFN and ACS Guidelines suggest a congruence that can be used to articulate best practices with regard to the criteria for and the definition of authorship, duplicate submission and previous publication, public disclosure before publication, conflict of interest disclosure, data sharing and deposition, subjects' protection, and digital image integrity. Copyright transfer to the publisher is still widely held as the norm, but the recently implemented policies of *Nature*, *Science* and *PNAS* seem to be a harbinger of change in this area. In this connection, access policies to publications on websites or on public databases are emerging and will undoubtedly undergo evolution as open access publication continues to change. A case for clinical trials registration being a best practice can be argued based on the large number of journals that use the ICMJE Uniform Requirements.

It is interesting to note that *Nature*, *Science*, and *PNAS* all publish papers beyond the scope of biomedical and life sciences. Thus, the standards that are found in their publication policies have an impact on a broad range of research disciplines. Similarly, the contributions of Plemmons (2011); Bebeau and Monson (2011); and Jason Borenstein (2011) in this volume demonstrate that some of the standards discussed in this paper apply to the social science and engineering disciplines, suggesting common practices across widely disparate fields. Continued study of trends and policies will be necessary in the building of a broad foundation of authorship standards.

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