Scientific Societies and Promotion of the Responsible Conduct of Research: Codes, Policies, and Education

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Abstract

Scientific societies have a significant opportunity to contribute to the promotion of responsible conduct of research (RCR) and to RCR education. The degree to which societies engage such opportunity spans a broad range. There are three principal ways RCR may be promoted by scientific societies. The first is through codes of conduct encouraging their membership to practice ethical research according to the tenets of these codes. The second is through specialized policies (e.g., publication practices) developed by scientific societies that help define normative behavior. Finally, societies have a role to play in creating materials and resources aimed at educating scientists and trainees in matters pertaining to proper research conduct. This article illustrates examples of each of these activities embraced by different scientific societies. The American Society for Microbiology is used as a specific example of a society that has been proactive in each of these three areas. Scientific societies need to recognize the impact they can have on promoting RCR and to expand their efforts in these three and other relevant areas. The examples provided demonstrate the components of a model for all scientific societies to follow in promoting RCR.

Acad Med. 2007; 82:865–869.

The environment in which we conduct scientific research continues to evolve, and scientific societies should recognize such changes as an opportunity to refine existing policies or develop new policies that bear on the responsible conduct of research (RCR). Regulations from the federal government or other sources emerge regularly and must be taken into account by scientific societies as they refine their existing codes accordingly. For example, federal policies that deal with objectivity in research or the sharing of data[1,2] have an impact on the interpretation and implementation of such codes. Changes in the reporting of research results have created another impetus for reexamination of normative codes and policies. For example, electronic publication practices raise new issues that range from intellectual-property protection to the appropriate processing of digital images. Finally, the rising threat of global terrorism has created a heightened awareness of the social responsibilities of scientific research. Doing and reporting research that may be used for intentional harm as well as good—so-called dual-use technology—has come under discussion and debate.[3] Some scientific societies have engaged in this debate, embraced ethical positions that address this issue, and even created publication policies that deal with it. Finally, all of these elements of change provide an opportunity for scientific societies to develop and disseminate relevant educational materials.

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Overview of RCR in Scientific Societies

The role for scientific societies in fostering research integrity has been evolving in the past 25 years. An American Association for the Advancement of Science (AAAS) survey of its affiliate societies conducted in 1980 concluded that "little attention and only minimal resources" were being given to promote professional ethics among scientific and engineering societies.[4] A survey conducted by the Council of Scientific Society Presidents in 1994 revealed that 36 of 62 societies (58%) had some type of code of ethics, but few had mechanisms for enforcing the policies they articulated—that is, investigating and prosecuting allegations of ethical misconduct.[5] A second AAAS survey conducted from 1999 to 2000 found that 39 of 57 societies (68%) had adopted codes of ethics.[6] More than half of the reporting societies in this AAAS survey reported that they had specific policies on publication ethics (56%) and on data handling (51%).

In 2000, the AAAS and the U.S. Office of Research Integrity (ORI) cosponsored a conference that examined the role of scientific societies in promoting RCR. The initial report of this conference was published online,[7] and a complete report of this conference may be found in a special issue of *Science and Engineering Ethics* published in 2003.[8] The papers in that volume affirm that scientific societies have an important role to play that spans a variety of activities. At the same time, the content and commentary of that report suggest that scientific societies play varied and divergent roles in promoting RCR. Although these published proceedings provide baseline information on how scientific societies may engage RCR, comprehensive data on their role in promoting RCR are not available.

At present, the ways in which scientific societies may promote RCR may be grouped into three categories: (1) creation, promotion, and enforcement of codes of conduct, (2) publication of guidelines and policies pertaining to scientific conduct (e.g., authorship practices, mentoring responsibilities), and (3) development and dissemination of relevant educational materials.

For purposes of discussion here, codes of scientific societies generally describe rules

to which members are expected to adhere in practicing their profession. Policies describe an expected course of action to be taken in some defined process, such as preparation of a manuscript. Guidelines, on the other hand, comprise recommendations that are intended to provide advice to the membership on a specific process. In this article, I will provide some specific examples of how scientific societies have engaged in these three categories of activity. The examples illustrate the value of scientific societies committing to ongoing activities that promote and enhance RCR from the standpoints of both scientific practice and education.

Codes of Conduct and RCR

Descriptions of the development and implementation of ethical guidelines or codes of conduct for the International Society of Environmental Epidemiology,[9] the American Sociological Society,[10] and the American Society for Microbiology (ASM)[11] have been published. The code of ethics of the ASM provides a useful case study. This code was adopted in 1988 and was revised in 2000 to reflect changes in the growing culture of RCR to include language that captured the federal definition of scientific misconduct (fabrication, falsification, and plagiarism), data-sharing expectations, and issues related to conflicts of interest. Recently, the ASM has further revised its code of ethics to invoke an awareness of dual-use research. In 2005, the ASM Code of Ethics[12] was amended to read:

> ASM members are obligated to discourage any use of microbiology contrary to the welfare of humankind, including the use of microbes as biological weapons. Bioterrorism violates the fundamental principles upon which the Society was founded and is abhorrent to the ASM and its members. ASM members will call to the attention of the public or the appropriate authorities misuses of microbiology or of information derived from microbiology.

We see in this evolution of the code one example of a scientific society taking a proactive role in the development and promulgation of standards for RCR. As I will discuss below, this aspect of the ethics code is now manifest in the ASM's publication policy.

Guidelines and Policies Pertaining to RCR

In addition to codes of ethics, scientific societies may issue policies that provide guidance in specific areas of research conduct, such as mentoring, conflicts of interest, and use of research subjects. One such example that I will examine in detail is the question of authorship.

An overview of authorship policies

Societies that publish their own journal or journals usually provide guidance in the area of authorship. Here, policy is articulated in instructions to authors. These instructions provide a breadth of information about the publication process from policies on manuscript preparation and peer review, to data-sharing requirements, to criteria for authorship. Examination of such instructions, now typically found online at a given journal's Web site, provides useful information on many aspects of publication norms. Broad surveys of authorship criteria taken from various journals' instructions to authors, including journals published by scientific societies, have allowed consensus building of key authorship criteria.[13–15] In addition to instructions to authors, scientific societies also may use separate publication policies as overarching documents to articulate philosophical and practical matters related to their journals. Both instructions to authors and society publication policies are dynamic in nature and are subject to revision and updating on a periodic, sometimes frequent, basis.

The ASM authorship policy

The ASM continues as a useful exemplar to illustrate this topic. The ASM currently publishes 12 scholarly, peer-reviewed journals. All ASM journals have included the same information on authorship criteria in their instructions to authors for more than two decades. In the mid 1980s, the information relevant to authorship in one of the society's journals read as follows: "An author is one who made a substantial contribution to the overall design and execution of the experiments; therefore, ASM considers all coauthors equally responsible for the entire paper. Individuals who provided assistance, eg, supplied strains or reagents or critiqued the paper, should not be listed as authors but should be recognized in the Acknowledgment section." This guidance was updated and expanded in 1998, 2003, and, most recently, 2006.[16]

The detail of the 2006 guidance goes considerably beyond that seen 20 years earlier:

> An author is one who made a substantial contribution to the overall design and execution of the experiments; therefore, ASM considers all authors responsible for the entire paper. All authors of a manuscript must have agreed to its submission and are responsible for its content, including appropriate citations and acknowledgments, and must also have agreed that the corresponding author has the authority to act on their behalf in all matters pertaining to publication of the manuscript. All authors must agree to the order in which their names are listed in the byline. A change in authorship (order of listing or addition or deletion of a name) after submission of the manuscript will be implemented only after receipt of signed statements of agreement from all parties involved.[17]

Clearly, this level of detail sets specific standards that carry the endorsement of the scientific society. The membership of the society and the relevant scientific community have an authoritative source to consult regarding norms and values related to authorship. Equally important, the society's values form the foundation for educating trainees.

Extended view of authorship norms and scientific societies

The impact that scientific societies may have on establishing publication standards can be more broadly illustrated by considering the requirements encoded by the International Committee of Medical Journal Editors (ICMJE). The ICMJE comprises a small group of general medical journal editors. The committee established guidelines for uniform requirements for manuscripts submitted to biomedical journals in 1978 and has updating them periodically since.[17] The ICMJE guidelines are rigorous, and they have much to say about the criteria and responsibilities of authorship in particular. Evolution of the criteria for authorship since the initial 1978 publication has occurred in a fashion not unlike that outlined above for the ASM. The ICMJE criteria for authorship have evolved to be quite specific, stating that "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."

Several hundred journals have adopted the ICMJE guidelines, including a substantial number of those published by professional societies or organizations. Thus, although the ICMJE is not an open-membership organization, it has made an impact in promoting standards in responsible authorship though the adoption of its guidelines by professional societies such as the American Medical Association, the American Dental Association, and others. The ICMJE requirements have become standards that are widely invoked in the teaching of RCR. The detail of the ICMJE guidelines is suitable for exposing trainees to basic ethical principles in reporting research and related conduct. The guidelines also provide trainees with a succinct narrative that spells out the basis of authorship credit, assignment of responsibility, justification for inclusion in the acknowledgment section, and issues related to conflict of interest as it applies to authors, editors, and peer reviewers. Other topics include issues related to peer review and the protection of research subjects. In short, these guidelines are an authoritative primer for use in teaching about authorship and publication practices in RCR courses. The acceptance of these guidelines by a number of scientific societies validates their merit.

Finally, some scientific societies have developed extensive documents dealing with publication practices. These societies have gone above and beyond what is found in instructions to authors to reflect the importance that they place on the ethics of scientific publication. Two noteworthy examples are the Society for Neuroscience[18] (SFN) and the American Chemical Society[19] (ACS). The content of ACS guidelines served as a model for the SFN committee that prepared the neuroscience guidelines, so the content of both is similar. Both cover, in detail, the obligations of editors, authors, and peer reviewers in the scientific publication process. The ACS and SFN guidelines also provide guidance for researchers who publish outside of the scientific literature. The SFN guidelines contain a section on dealing with possible scientific misconduct.

The subject matter of publication ethics also is dealt with in detail in both of these documents. The scope of coverage leaves little to the imagination of the first-time author, and it provides a good source of reference information to the seasoned investigator. In addition their usefulness to new or seasoned scientists, a compelling case can be made for using documents such as these as trainee-teaching tools in RCR.

Dual-use technology and scientific publication

Further evolution in the ASM Publication Policy is seen in the consideration of dual-use implications. In 2003 the ASM added a section called *Use of Microbiological Information* to the editorial policy statement contained in its instructions to authors for all of its journals.[16] This two paragraph statement reiterates the principles mentioned in the society's code of ethics (see above) and affirms that bioterrorism violates principles of the code and "is abhorrent to ASM and its members." The statement goes on to invoke the process of peer review of manuscripts containing information that could be used inappropriately, saying that "members of the ASM Publications Board will evaluate the rare manuscript that might raise such issues during the review process." In 2003, the AAAS also added language with similar implications to its *General Information for Authors* in the journal *Science*, the official publication of the AAAS. This document has evolved slightly since that time, so that the 2007 instructions read: "Some papers may present potential security concerns. Such papers will be brought to the attention of the Editor-in-Chief for further evaluation. If necessary, outside reviewers with expertise in this area will be consulted."[20]

Both the ASM and AAAS statements on security implications of research results imply that a manuscript could be rejected on the grounds that it represents a problem in terms of dual-use research. In effect, this affirms that scientists bear responsibility for the research they do and that professional societies are willing to invoke the means to prevent the dissemination of knowledge that, on balance, has significant potential for harm.

As important as this message is, it leaves us grappling with some problematic issues. The first is the inability to readily classify research as *dual use*. Although the National Science Advisory Board for Biosecurity (NSABB)[21] has recently developed categories of experiments that present dual-use concerns, much if not most research could fit the description of dual use. Developing a useful definition may be difficult and a long time coming. A related argument involves the reality of an expansive research literature, with thousands of journals in print in all fields of scientific research. At present, the policies of the ASM and AAAS journals are the exception, not the rule, among scientific society journals, and even if they become widely adopted in years to come, finding a journal that will publish a controversial paper with dual-use implications is not likely to be difficult. Last, although the scientific societal codes and policies promote a culture of conscience and responsibility, the practical matter of monitoring and enforcement ultimately falls on individual institutions.

In the case of research that is frequently considered under the rubric of dual use, oversight by federally mandated institutional biosafety committees (IBCs) is required in institutions receiving federal funding. Institutionally based IBCs were formed in the 1970s to provide local review and oversight of research involving recombinant DNA. Since that time, many institutions have expanded (at their own discretion) the oversight activities and responsibilities of their IBCs to include biological hazards, use of select infectious agents, and other potentially hazardous agents.[22] For proposed research involving pathogenic organisms or agents, toxins, or other virulence factors that can affect humans, animals, or plants, the typical IBC may well find itself confronted in the future with issues and decisions that fall under the umbrella of dual-use concerns. Whether this transformation actually happens, and whether IBCs will have the expertise and resources to deal with this challenge, remains to be seen.

That a few scientific societies have articulated positions on the misuse of research results can set the stage for

engagement by a given institution's IBC. IBCs also should benefit from the establishment of the NSABB, formed in 2004, to provide advice and guidance to the federal government on biological research that may yield results that could be misused and, thus, pose a public health or national security threat. In 2005, the NSABB was asked to consider a manuscript submitted to *Science* that reported the reconstruction of the pandemic flu virus of 1918. On the basis of the recommendations of this board as well as the journal editors and peer reviewers, the paper was accepted and published.[23] Although the ASM and AAAS journal policies on security issues are relatively new, this manuscript provided a unique test. However, it is not clear whether this will turn out to be a plausible model in the long run.

Policies and educational materials in other RCR core areas

The ORI recommends nine core areas of RCR instruction: (1) data acquisition, management, sharing, and ownership, (2) conflict of interest and commitment, (3) human subjects, (4) animal welfare, (5) research misconduct, (6) publication practices and responsible authorship, (7) mentor–trainee responsibilities, (8) peer review, and (9) collaborative science. Because many scientific societies publish scholarly journals, guidance on authorship and publication practices is naturally encountered in society writings and policies. The examples given above amply demonstrate this assertion. Another example of an RCR core content area where one may look to scientific societies for guidance is the use and protection of animal subjects (animal welfare). Two scientific societies in particular present a rich array of materials on their Web sites that can serve a useful reference for established investigators, while at the same time serving as educational materials for trainees and those new to research that employs animals. The Society for Toxicology[24] site contains position statements and guiding principles for animal research, relevant slide presentations dealing with the use of animals in research, news stories, links to other educational sites, and links to regulatory agencies. Similar kinds of materials for use by scientists and trainees may be found on the Web site of the American Physiological Society[25] (APS), as well as materials aimed a explaining to the general public the rationale for and uses of animals in research. The APS also publishes a number of scholarly journals, so guidance on authorship and publication practices may also be found on the society's Web site. Material on mentoring that is suitable for RCR educational purposes may also be found on the APS Web site, including guidance handbooks for both trainees and for mentors. In addition, the Federation of American Societies for Experimental Biology, of which the APS is a participating society, has developed guidelines for an individual development plan to be used in the training of postdoctoral fellows.[26]

Contributions to RCR Education

Scientific societies can play a role in education in RCR. A defining feature of such societies is the national meeting of the membership. Such meetings provide a forum for symposia and special programs on topics in RCR. Society-sponsored symposia demonstrate leadership that can have a broad impact. Such activities reach a cross-section of a society's membership, from all levels of trainees, to scientific staff, to scientists, to administrators. RCR symposia at a number of recent meetings were the result of special projects funded under the ORI's RCR Program for Academic Societies and jointly administered by the ORI and the Association of American Medical Colleges (AAMC).[27]

Since the ORI–AAMC program was initiated in 2003, 39 grants to 33 academic and scientific societies have been awarded. In addition to meeting symposia, sponsored activities included roundtable discussions, lectures at national meetings, educational curriculum development including computer-based teaching tools, writing legal and ethical guidelines relevant to the discipline of the society, guidebook development and evaluation, publication of symposia manuscripts, and development of policies on such topics as authorship, data management, and assorted RCR best practices.

Emerging products from the ORI–AAMC joint endeavor may be accessed at an AAMC Web site and include curriculum modules for a variety of RCR topics (e.g., managing conflicts of interest, subjects protection, peer review, mentorship, collaborative science, responsible literature searching), a society code of ethics, consensus statements on improving research integrity, and published manuscripts of meeting proceedings on ethical and RCR topics.[28]

These kinds of educational contributions are ad hoc in some cases, whereas in others they provide the basis for the establishment of ongoing resources that can be revised and used for considerable periods of time. At least one scientific society, the ASM, has published a textbook designed for use in RCR courses.[14] The book is broadly aimed at all disciplines in the biomedical and life sciences, with graduate and postdoctoral trainees intended as the primary audience. ASM Press, the imprint of the society, published the first edition in 1995, with second and third editions in 2000 and 2005. The current edition of the book has a companion Web site and features a variety of teaching tools, including case studies, as well as attitude and knowledge surveys for promoting classroom discussion.[29]

Conclusion

Scientific societies have unique opportunities to heighten the awareness of researchers to the ethical issues surrounding the responsible practice of science. Similar opportunities exist for education in this area. The examples provided here illustrate how scientific societies can take a proactive approach to contribute to RCR in each of three main areas: codes, policies, and education. Several scientific societies that have been active in some or all of these areas serve as examples—particularly the ASM, which has seriously engaged all of these areas. Policies that emanate from the values and norms established by a scientific society provide concrete guidance for scientist members and an educational substrate for the socialization of trainees. Scientific societies with ethics codes and policy documents should work to keep them relevant and widely disseminated. Scientific societies should consider working together to develop, where appropriate, global codes of scientific ethics and conduct, and societies that have not yet developed ethical codes should do so. Similarly, scientific societies should develop relevant policies that promote members' awareness and practice of RCR. Scientific

societies can and should provide resources for educating scientists and trainees in RCR, and instructors should use scientific society codes, policies, and other relevant resources in their RCR teaching. These policies and actions can serve as the foundation for normative behavior and, in doing so, promote a culture of RCR across the scientific community.

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