COMMENTS

Scientific Misconduct and Research Integrity for the Bench Scientist (44535E)

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Abstract. **This paper describes the role of the Office of Research Integrity (ORI), a component of the Public Health Service (PHS), in defining scientific misconduct in research supported with PHS funds and in establishing standards for responding to allegations of misconduct. The principal methods by which ORI exercises its responsibilities in this area are defining what types of behaviors undertaken by research investigators constitute misconduct, overseeing institutional efforts to investigate and report misconduct, and recommending to the Assistant Secretary for Health (ASH) PHS administrative actions when misconduct is identified. ORI also takes affirmative steps to promote research integrity through education, training, and other initiatives. The role of the research institution in responding to misconduct and promoting research integrity is complementary and overlapping with ORI's efforts but, as the employer of research investigators and front-line manager of the research, the institution has a greater opportunity to promote the highest standards of integrity in the day-to-day conduct of research. Finally, legal precedent established through civil litigation has played an important role in defining the standards that apply in determining when a breach of research integrity has occurred.**

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Following preparation of this article, new federal and Department of Health and Human Services (HHS) policies (hereafter new federal policies and new HHS policies) on scientific misconduct were announced (1, 2). These policies are generally consistent with the current PHS scheme for handling allegations of misconduct in that they assign the primary responsibility for handling allegations to the research institution, use a two-step process of inquiry and investigation to review allegations, require the institution to report investigations to the relevant federal agency, and provide for federal oversight. They also propose a new federal definition of "research misconduct," which is defined as "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results"(1). This new definition will not become effective for HHS until after it is adopted in final form by the Office of Science and Technology Policy (OSTP) and, subsequently, promulgated in a revised PHS regulation. Thus, the PHS regulatory provisions discussed below are still current. Implementation of the new HHS policies will be phased in over the next year and updates on this process will be included in the ORI Newsletter and the ORI web site (http://*www.ori.dhhs.gov* under the "What's New" section).

ORI was established in 1992 when two prior offices in HHS with responsibility for handling misconduct in science matters were consolidated and moved to the Office of the Assistant Secretary for Health (OASH) (3). In 1995, as part of a general reorganization of OASH, ORI became part of the Office of Public Health and Science, a component of PHS in the Office of the Secretary (4, 5). In 2000, following adoption of new HHS misconduct policies, ORI was reor-

The opinions expressed herein are those of the author and do not necessarily represent the views of the Office of Research Integrity, the U.S. Department of Health and Human Services, or any other federal agency.

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ganized to focus more on education, prevention, and oversight activities, and responsibility for making final PHS decisions on misconduct was assigned to the ASH (6).

ORI's mission includes developing policies and regulations governing scientific misconduct, including the definition of misconduct; ensuring that research institutions have adequate policies and procedures in place for investigating and reporting allegations of scientific misconduct when PHS-supported research is involved; overseeing institutional investigations of misconduct; referring allegations that require direct HHS investigations to the Office of Inspector General (OIG); recommending findings of scientific misconduct and administrative actions to the ASH who makes the final decision on misconduct, subject to appeal; developing and presenting findings of misconduct before the HHS Departmental Appeals Board (DAB) when the accused scientist requests a review of a proposed PHS misconduct finding; and, promoting research integrity activities through collaborative efforts with research institutions, scientific societies, and professional organizations (6, 7). All of these responsibilities support ORI's general mission to take a leadership role on behalf of the PHS to respond to identified misconduct and to initiate steps to prevent misconduct and promote research integrity.

In discussing how federal standards for scientific misconduct affect bench scientists, the logical place to start is with the definition.

The Federal Definition of Misconduct in Science

PHS established the following definition of "misconduct in science" through federal regulation in 1989: "Fabrication, falsification, plagiarism, or other practices that seriously deviate from those that are commonly accepted within the scientific community for proposing, conducting, or reporting research. It does not include honest error or honest differences in interpretations or judgments of data" (8).

Several elements of this definition warrant discussion. The core part of the definition is fabrication, falsification, or plagiarism in proposing, conducting, or reporting research. This includes fabrication, falsification, or plagiarism of the research data, results, or significant methodology that occurs during preparation of the research proposal, conduct of the research, or reporting of the research in papers, progress reports, or elsewhere. In some cases, findings of misconduct have been made where falsified data have been presented at lab meetings or included in grant proposals or submitted manuscripts that were subsequently withdrawn (9). The DAB has ruled that scientific misconduct committed in grant applications, even unfunded ones, is subject to ORI's jurisdiction.

The clause in the definition that reads "other practices that seriously deviate" from those that are commonly accepted in the scientific community has been a point of concern and criticism in the scientific community. Critics contend that the term is too vague and open-ended such that a reasonable scientist would not know in advance what conduct was prohibited. ORI has tended not to rely on this part of the definition and has largely restricted its findings of misconduct to fabrication, falsification, or plagiarism (10). ORI findings of scientific misconduct are published in the Federal Register and the ORI Newsletter.

ORI has also issued some policy guidance on its interpretation of plagiarism by explaining that it does not consider plagiarism to include disputes over the order of authorship, disagreements between current or former collaborators over ownership of shared ideas, or the minor copying of text, including commonly used descriptions of methodology (11, 12).

What is not included in the definition is also significant. ORI receives many allegations of breaches of research integrity, such as violations of human subject or animal care regulations or Food and Drug Administration requirements for drug testing on humans, that do not fall within its jurisdiction. As stated in the applicability section, the regulations are "not intended to set up an alternative to established procedures for resolving fiscal improprieties, issues concerning the ethical treatment of human or animal subjects, or criminal matters" (13). Consistent with this language, a clause in the proposed definition of misconduct that would have included "material failure to comply with federal requirements that uniquely relate to the conduct of research" was dropped from the final regulation (14).

One issue not explicitly addressed in the 1989 regulation was the legal standard for applying the definition of misconduct to an accused scientist, such as what standard of evidence should be applied and whether some level of intent was required. In issuing its 1992 guidelines for accused scientists to appeal proposed ORI misconduct findings to the DAB, HHS announced that the preponderance of the evidence standard would be applied in deciding whether misconduct occurred, and ORI would have the burden of proof in demonstrating that such standard had been met (15). DAB decisions have also clarified that to find scientific misconduct ORI must be able to demonstrate that a researcher has engaged in prohibited conduct "intentionally" (16–18). A mistake made by carelessness, poor scientific practices, or lack of competence alone would not normally be sufficient to show misconduct. The ultimate parameters of what level of "intentional" behavior constitute misconduct have yet to be defined and await further development by case law.

The other federal agency with substantial experience in handling misconduct in science cases is the National Science Foundation (NSF). NSF has a definition of misconduct that is similar to that of PHS in that it also includes "fabrication, falsification, plagiarism, or other serious deviation from accepted practices" (19). However, there are two important differences. The NSF definition covers "retaliation of any kind against a person who reported or alleged misconduct and who has not acted in bad faith." In contrast, the PHS regulations require research institutions to undertake

"diligent efforts to protect the positions and reputations of those persons who, in good faith, make allegations" but does not consider retaliatory actions to be PHS scientific misconduct *per se* (20). In PHS' view, retaliatory acts are wrong and should be sanctioned but are not properly considered misconduct in science, which is generally restricted to misbehavior in constructing and reporting the scientific record. However, research institutions may choose to define retaliation as misconduct under their own internal policies or otherwise prohibit and sanction retaliatory acts.

The other key difference between the NSF and PHS definitions is the treatment of the "other serious deviation" feature of the definition. Whereas ORI has tended not to rely on the "other practices that seriously deviate" clause, NSF has stated the importance of its similar clause to the definition based on its view that fabrication, falsification, and plagiarism do not exhaust the types of misbehavior that would warrant sanction as misconduct in science (21). In one case that resulted in some controversy, NSF found misconduct on the part of a principal investigator who sexually abused graduate and undergraduate women under his supervision (22, 23). Although no fabrication, falsification, or plagiarism occurred, this activity was considered a corruption of the research process that warranted a finding of scientific misconduct (22, 23).

Although no final action has been taken, OSTP has been working on a proposed common federal definition of scientific misconduct and some common principles and procedures for all federal agencies to follow (24). The proposed federal definition was announced on October 14, 1999, and defines "research misconduct" as "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results" (1). It also includes separate definitions of "fabrication," "falsification," "plagiarism," and "research record" and states that a finding of research misconduct required that:

- There be a significant departure from accepted practices of the scientific community for maintaining the integrity of the research record;
- The misconduct be committed intentionally, or knowingly, or in reckless disregard of accepted practices; and
- The allegation be proven by a preponderance of evidence.
- The definition also deletes the "other practices that seriously deviate" clause that has been a point of controversy in the current federal definitions.

Following consideration of public comments, OSTP expects to finalize the new federal definition in 2000. The federal research agencies will then be directed to implement the federal definition and policies. PHS expects its implementation to be accomplished through a revised regulation that will take a number of months to finalize. In the meantime, the current PHS definition and regulations remain in effect (8).

Investigation and Resolution of Allegations of Misconduct

Under the PHS regulations, institutions that receive research funds from the PHS agencies have the primary responsibility for reviewing allegations of scientific misconduct, conducting inquiries and investigations as needed, and reporting substantial allegations (those that warrant investigation) to ORI (25, 26). When ORI receives a report of an institutional inquiry (27) or investigation into allegations of scientific misconduct, it conducts an oversight review to determine whether the institutional proceeding was sufficiently thorough, objective, and complete to permit final resolution and closure of the case. While most ORI oversight reviews are conducted on investigations, ORI may also conduct an oversight review of an inquiry report. This usually occurs under two circumstances: (i) when the whistleblower makes an allegation directly to ORI and ORI requests an institution to conduct an inquiry or (ii) a whistleblower comes to ORI after an institutional inquiry and asks ORI to take a second look at the allegations and institutional response.

The oversight review usually results in agreement on the findings between the institution and ORI. However, ORI occasionally concludes that it is unable to base the PHS finding on the institutional finding because of differences in the definition of scientific misconduct, assessment of the evidence, or other pertinent factors. Under these circumstances, ORI may decline to pursue the allegation, or it may refer the allegation to the HHS OIG for investigation (2, 28). HHS may conduct its own investigation at any time prior to, during, or following an institution's investigation. Under the new HHS policies adopted October 22, 1999, OIG will conduct extramural investigations of alleged scientific misconduct when an HHS investigation is required (2). ORI will review the investigation and make appropriate recommendations to the ASH for resolution. Although HHS is authorized to conduct its own investigation at any time, ORI relies primarily on institutions to conduct investigations involving extramural research. Since 1995, ORI has conducted extramural inquiries and investigations less than 5% of the time. Of 134 extramural cases opened from January 1, 1995–August 30, 1998, ORI has conducted the inquiry or investigation in only 6 cases and relied on the institutional inquiry or investigation in 128 cases. If ORI finds the investigation report deficient, it will ask the institution to conduct additional analyses or, if necessary, recommend to the ASH that the institution be directed to reopen the investigation.

When ORI completes an oversight review of an institutional inquiry or investigation, it usually prepares an ORI oversight report that describes the institutional process and, in the case of an inquiry, concludes whether an investigation is warranted or, in the case of an investigation, concludes whether misconduct has occurred. When ORI does not make a finding of scientific misconduct following an inves-

tigation, it sends a copy of the oversight report to the institution and requests that the institution notify the respondent and whistleblower directly of the outcome of the investigation. When ORI decides to close a case by finding misconduct, it will usually do so through a written settlement agreement with the respondent. ORI has made over 100 findings of scientific misconduct from June 1, 1992, when ORI was established, through January 1, 2000. Under new procedures adopted by HHS, the ASH will make final decisions on settlements and proposed PHS findings of misconduct. ORI will continue to conduct oversight reviews of institutional investigations and recommend settlements and proposed misconduct findings to the ASH. In those cases where a settlement is not obtained or is deemed inappropriate, the ASH will notify the respondent and the institution of the proposed misconduct finding and advise the respondent of his or her opportunity to request a hearing on the ASH decision. This hearing is conducted by the DAB that provides a trial type proceeding where the accused scientist can present evidence and witnesses to rebut the PHS misconduct finding, be represented by counsel, and cross-examine any ORI witnesses (15).

When a PHS misconduct finding is sustained either through settlement with the accused scientist, a decision by the scientist not to appeal the misconduct finding, or affirmance of the PHS finding following an appeal, various administrative actions are taken against the scientist to protect the integrity of PHS funds and PHS-sponsored research. The most serious action is debarment of the scientist from applying for federal funds for a term of years (29). For a less serious finding of misconduct such as minor falsification or plagiarism or an infraction by a student or non-professional staff, special supervision or certification of data or sources by the researcher's institution may be imposed in lieu of debarment. Finally, correction or retraction of scientific articles may also be required where the scientific record has been corrupted by the misconduct.

Research Institutions' Plenary Authority for Misconduct

In the discussion above, we described the PHS definition of misconduct and briefly discussed the institutional investigation of allegations and ORI's response to such allegations. PHS cases of misconduct are limited to situations where PHS research funds or applications for such funds are involved, and the alleged misconduct falls within the rather narrow PHS definition of misconduct (i.e., fabrication, falsification, or plagiarism). Thus, PHS incidents of misconduct comprise a small subset of the many types of misconduct and research integrity issues that can arise at institutions.

An institution may find a wide variety of investigator conduct to violate its own internal standards and policies even when that same conduct would not constitute PHS scientific misconduct. ORI's position is that a PHS decision not to accept an institutional finding of misconduct does not affect the institution's ability to find scientific misconduct, academic misconduct, or just a violation of institutional policies under the institution's own definitions and legal standards. ORI further clarifies: "Scientific misconduct under the PHS standards must meet certain legal requirements which may be greater, lesser, or different from an institution's own internal standards. Therefore, in the course of an investigation, an institution may find conduct to be actionable under its own standards, even though the action does not meet the PHS definition of scientific misconduct. If ORI reaches a determination that a particular action does not fall within the PHS definition of scientific misconduct (as opposed to whether the action actually occurred), this PHS finding should not affect the institution's internal finding or any administrative actions that it imposes" (30). In this regard, the institution is considered to have plenary authority to govern the conduct of its employees, students, post-docs, and other research staff under institutional policies and legal authorities that may be more expansive than PHS' limited authority.

A couple of examples will illustrate how this plenary authority of the institution works in practice. In one case in which no PHS funds were involved, ORI was asked whether a dispute between former collaborators on a grant application would fall within the PHS definition of plagiarism. The two collaborators, Scientists A and B, jointly submitted a grant application that was not funded. Subsequently, Scientist A submitted a revised application to a different entity that did provide funding. Scientist B then alleged plagiarism of his text and intellectual contribution from the original application that he claimed was used in the second application without his permission. ORI advised the accused scientist, Scientist A, that it did not consider the allegation to constitute plagiarism because ORI considers disputes between former collaborators over authorship or intellectual theft of ideas as falling outside the PHS definition of misconduct. However, ORI further stated that its interpretation was not binding on the institution that could find misconduct under its institutional policy without regard to ORI's views. The institution ultimately found misconduct against Scientist A, and its decision was upheld in a subsequent administrative hearing.

The second case involved alleged "duplicate publication" in which the scientist was accused of publishing the same article twice without advising either the second publisher or the readers that the article had been published previously. In conducting its oversight review of the case, ORI determined that duplicate publication did not fall within its definition of misconduct and so advised the institution. However, the institution found a violation of its institutional policy, and the accused scientist filed suit against the institution. The court concluded, consistent with ORI policy, that the failure of ORI to find misconduct under the PHS definition did not diminish the authority of the institution to interpret and enforce its own policies and procedures. In *Shovlin* v. *University of Medicine and Dentistry*

of New Jersey, the court stated that "[E]ven though the federal agency [ORI] to which the university reported may not have considered duplicate publications to constitute 'misconduct in science,' it recognized the university's right to hold such practice unacceptable" (31).

In 1995, ORI reviewed definitions of misconduct from 46 research institutions and determined that 29 of the definitions went beyond the PHS definition (32). Some of the types of researcher conduct covered by these definitions were "wrongful manipulation of data or results," "arbitrary or biased data selection," and "unauthorized use of confidential information" (32). While the ultimate meaning of the terms depends upon institutional interpretation and application, these definitions may cover investigator activities not captured by the PHS definition of intentional fabrication, falsification, or plagiarism. They may also overlap with certain "questionable research practices" that the National Academy of Sciences does not consider to be misconduct in science (33). The National Academy of Sciences considers "questionable research practices" to include misbehavior such as "using inappropriate statistical or other methods of measurement to enhance the significance of research findings" and "misrepresenting speculation as fact" (33).

Other institutional definitions include broad catch-all clauses that provide potentially wide discretion for institutions to determine misconduct on a case-by-case basis according to the egregiousness of the researcher's conduct. These clauses may be subject to the same criticism of vagueness and overbreadth that has been made against the PHS' "other practices that seriously deviate" clause. Examples of these institutional catch-all clauses are:

- Material failure to comply with governmental or institutional requirements affecting specific aspects of the conduct of research (e.g., protection of human subjects and the welfare of laboratory animals);
- Failure to meet other professional standards or legal requirements governing research;
- Actions that cast doubt on the integrity of research and research results; and
- Any act that violates the standards of integrity in the conduct of scholarly and scientific research and communications.

In addition to its plenary authority to sanction a wide variety of misconduct that extends beyond the PHS definition, the research institution has the authority, and many would say the responsibility, to take affirmative steps to promote research integrity through training, education, and the establishment of institutional standards and expectations. The types of activities institutions have undertaken in this area are discussed in the next section.

Promotion of Research Integrity: Federal and Institutional Responsibilities

The federal research integrity activity that is probably the best known is the National Institutes of Health (NIH) requirement for institutions to provide education in the responsible conduct of research to all students, fellows, and others who are receiving training under an NIH research training grant (34). Some institutions have expanded the availability of such courses to include all graduate students in the research disciplines or other groups besides NIH trainees (35). The Commission on Research Integrity has also recommended that the requirement for education in responsible research be expanded to cover all individuals supported by PHS research funds (36). Consistent with this recommendation, one of the new HHS policies expands the NIH training grant requirement for education in the responsible conduct of research to all staff at research institutions who are engaged in research or research training under PHS grants, contracts, or cooperative agreements. PHS is expected to announce this expanded requirement early in FY 2001 with an as yet undetermined phase-in period for extramural institutions to implement this requirement.

NSF has a program on ethics and values studies that focuses on "developing and transmitting knowledge about ethical and value dimensions associated with the conduct and impacts of science, engineering, and technology" (37). This program funds both (i) research projects on topics such as research ethics and the affect of ethics and values issues on science policy and practice, and (ii) educational programs on ethics, values, and the conduct of science and engineering. In a somewhat similar focus, ORI is developing a research program on research integrity issues and sponsoring a conference (with co-sponsors the American Association for the Advancement of Science, the Association of American Medical Colleges, NIH, and NSF) on "Research on Research Integrity" in Bethesda, Maryland, on November 18–20, 2000. Areas of ORI's research interest include, but are not limited to:

- Career development, career pressures, and mentoring practices for graduate students, post-docs, lab technicians, and others;
- Responsible conduct of research training programs and their efficacy;
- Development of normative standards for research;
- Elements of a research environment that promote integrity;
- Role of professional associations and scientific societies in promoting integrity;
- Data recording, data retention, data analysis, quality control, and the management of laboratories;
- Authorship, review, confidentiality, plagiarism and publication practices;
- The incidence of misconduct in research, generally, and within specific fields (individually and comparatively);
- Detecting, reporting, and investigating alleged misconduct;
- The experience of respondents and whistleblowers, including retaliation; and
- Differential opportunity to commit research misconduct across scientific disciplines (38).

ORI also has certain other responsibilities to promote re-

search integrity and prevent misconduct. These functions are described in its delegation of authority from the Secretary of HHS which states that ORI is to "develop and implement research misconduct prevention and education activities for PHS extramural and intramural programs" and "conduct policy analyses and studies to improve DHHS research integrity policies and procedures" (39). ORI's recent reorganization stated that "the role and structure of ORI will be changed to focus more on preventing misconduct and promoting research integrity through expanded education programs" and states that ORI's authority includes "education and training in the responsible conduct of research, activities designed to promote research integrity and prevent misconduct, and research and evaluation programs" (6).

One of the principal means by which ORI promotes research integrity is through its workshop/conference program whereby it sponsors education and training programs on a variety of topics related to scientific misconduct and research integrity (40). Most of these programs are co-sponsored by a research institution, scientific society, or professional association although ORI will conduct such programs directly when appropriate. Small awards, up to $20,000, are made to the co-sponsor for the cost of conducting the program, and the co-sponsor usually proposes the topic, agenda, and faculty for the program. A list of conferences already given or planned and potential topics for new conferences is included in Figure 1.

Recently, ORI co-sponsored a conference with the University of Arizona on Management of Biomedical Research Laboratories (41). ORI's reason for sponsoring this conference is its belief that well-managed, productive laboratories are essential for the advancement of biomedical research and the training of the next generation of scientists and are more likely to follow the fundamental tenets of science in the search for truth and promote the highest standards of research integrity. ORI's long-range purpose in offering the conference is to reduce scientific misconduct and promote research integrity by working with research institutions and the scientific community to improve the management of research laboratories. The faculty for the conference was composed of experienced principal investigators and research administrators from 14 different institutions who addressed a variety of important topics, including the role of the laboratory director, managing the research agenda, quality control, and collaborative research.

Other topics addressed—mentoring, data management, and assigning credit for productivity—focused not only on quality management but also on the ethical climate in the lab and the training of junior researchers, post-docs, and students.

Some initial lessons drawn from the conference focus on the variety of management and human relations skills needed by successful lab managers. Whereas scientific excellence and creativity are widely recognized as a necessary quality in a principal investigator, it is less well recognized that competency in managing business and personnel issues is also needed. These skills are especially important in the current research environment characterized by increased de-

ORI CONFERENCE/WORKSHOP PROGRAM

HELD OR PLANNED

- Research Integrity Officer Workshop: to train institutional officials who handle or coordinate allegations of misconduct.
- University of Florida: institutional policies and procedures—the institutional and ORI views.
- University of Michigan: designing and implementing research integrity programs.
- University of North Carolina-Chapel Hill: from research to product—exploring issues of research integrity.
- University of Arizona: management of biomedical research laboratories, including issues that affect research integrity.
- University of Texas-Houston Health Science Center: professional and public responsibilities in research integrity.
- PRIM&R, Bethesda, MD: educating in the responsible conduct of research.
- Council of Biology Editors, Montreal: workshop on authorship issues.
- Sigma Xi, Albuquerque, NM: challenges in research integrity for managers of research organizations.
- NCURA, Nationwide Video Conference: making the right moves in handling misconduct allegations.
- AAAS, Washington, DC: the role and activities of scientific societies in promoting research integrity.
- AAAS, St. Charles, IL: practicum on responding to allegations of research misconduct.
- ORI, Bethesda, MD: research on research integrity conference.

POTENTIAL

- Role of scientific societies in promoting research integrity.
- Preventing scientific misconduct.
- Responding to research integrity issues through alternative dispute resolution techniques.
- Developing institutional guidelines for the conduct of research.
- Research environments that promote integrity.
- Legal issues in scientific misconduct and research integrity.
- Scientific misconduct and research integrity issues in the international community.
- Whistleblower issues in reporting misconduct.
- Responding to alleged misconduct by the accused scientist.

Figure 1. ORI conference/workshop programs.

pendence on new and expensive technologies, a greater opportunity and need for cross-laboratory collaboration, more regulation and oversight of research, additional pressure to generate faculty salary support from grants, and greater effort to patent and license research results. Successful management will not only advance the careers of the lab director/principal investigator but also those of the laboratory staff, post-docs, and students. It will also attract new staff and students to the laboratory.

On the other hand, poor management techniques, such as inadequate standards for record keeping, poor manuscript review, and ambiguous or arbitrary standards for assigning authorship and credit, can lead to a laboratory environment that fosters poor morale, suspicion, and scientific misconduct. It can also lead to disputes over authorship and credit for intellectual contribution or allegations of questionable research practices (that do not rise to the level of PHS scientific misconduct) which can cause extreme disruption for all members of the research team.

As a corollary to its interest in promoting research integrity, ORI intends to work with the scientific community to identify the important issues in misconduct and integrity and how to go about answering them. In two areas, the effect of misconduct allegations on the whistleblower and the accused, ORI has already begun the process of raising questions and getting preliminary answers (42, 43). It has recently funded a study to identify medical school policies on common research practices, such as record keeping, publications, and grant proposals, to determine if there are any standard practices in the research community. The study results will be used to develop workshops, provide technical assistance, and create a resource document for institutions.

As discussed above, institutions have plenary authority to address scientific misconduct and research integrity issues under their internal policies and procedures. Authority and responsibility extend beyond defined scientific misconduct and cover a wide variety of integrity issues, including questionable research practices and the promotion of the responsible conduct of research. In a very general way, the PHS regulations address this broad institutional responsibility by stating that institutions that apply for PHS research grants, "*shall foster a research environment that discourages misconduct in all research and that deals forthrightly with possible misconduct associated with research for which PHS funds have been provided or requested*" (Emphasis added) (44). Institutions have addressed their responsibilities in this area through a variety of mechanisms, including establishment of institutional policies and procedures, provision of education and training in responsible research, setting standards and expectations for the conduct of research, and implementation of some novel programs, such as an ombuds office for handling scientific research and integrity disputes.

Harvard Medical School, for example, has adopted a variety of policies and procedures to address research integrity issues, including policies on conflicts of interest, research sponsored by industry, guidelines for authors and editors, and guidelines for the responsible conduct of research, both basic and clinical. Many of these policies were adopted in response to particular types of problems such as disagreements over mentoring or scientific disputes that had occurred in the laboratory but did not rise to the level of misconduct. Although Harvard has had several misconduct cases over the years, it also has had many cases where initial allegations did not result in a finding of misconduct but identified sloppy research, poor laboratory management, or deviations from good scientific practices that warranted some level of institutional discipline or corrective action. These types of experiences were one motivation behind the adoption of some of the Harvard policies that address research integrity (45).

In the past few years, alternative dispute mechanisms, such as the services of an ombudsperson, have been used by some institutions to resolve research integrity disputes. The ombudsperson is a neutral complaint handler, or facilitator, who attempts to resolve a scientific/ethics dispute between colleagues or mentor-student on a mutually agreeable basis. This approach appears to be most suitable for issues that involve personal choice by the parties, such as a dispute over order of authorship or a personal conflict between a mentor and student.

Harvard Medical School established an ombuds program in the early 1990s that more recently has handled a number of disputes that involve research integrity issues. In its 1997/1998 Annual Report, the Harvard ombuds office reported that it handled 87 cases involving intellectual property issues, including issues related to ownership of work, authorship, conflict of interest, professional misconduct, misrepresentation of data, and plagiarism. The program's home page currently lists the following types of issues as appropriate for referral to the ombudsperson: professional/scientific misconduct, ethics/whistleblowing, and intellectual property (46).

The NIH has recently established its own ombuds program (located in the Cooperative Resolution Center) that is charged with attempting to resolve workplace issues that can include scientific and personal disputes involving mentorship, authorship, reagent sharing, data management, and career advancement (47). One purpose of the program is to resolve disputes before they become intractable. It also allows for resolution of research integrity disputes which do not rise to the level of misconduct, such as those involving authorship, in a more informal and appropriate way than could be accomplished if the aggrieved party filed a formal complaint of scientific misconduct (48).

ORI encourages informal or alternative dispute resolution (ADR) techniques in appropriate circumstances and has included such mechanisms in its existing guidelines on whistleblower protection (49). These guidelines provide the following alternatives for institutions to respond to allegations of retaliation against a whistleblower: conduct an investigation; resolve the matter through negotiation; or go to

binding arbitration. In one case of alleged retaliation reported to ORI, the institution and complainant agreed to binding arbitration, but the case was settled privately before the formal ADR activity took place. ADR techniques are also available to resolve either allegations that fall outside the PHS definition of misconduct or lingering disputes that remain after a misconduct investigation is closed without a finding of misconduct. In this regard, ORI does not consider disputes over authorship or credit between collaborators to be plagiarism or other scientific misconduct. However, when an allegation falls within the PHS definition of scientific misconduct, it must be resolved by the institution consistent with the PHS regulation and reported to ORI if it leads to an investigation.

Many institutions have NIH research training grants and, thus, train post-docs, graduate students, and others on research ethics and the responsible conduct of research. Some institutions have expanded these programs to cover other issues or constituencies.

The University of Michigan has established a Research Responsibility Program (RRP) open to all faculty, students, and staff, including NIH trainees, which is described as follows: "The program grows out of a strongly felt responsibility to introduce best practices and rigorous ethical analysis of research issues for all disciplines. The sessions cover topics mandated by NIH and will contain the basic elements to allow further exploration of these issues. NIH training grant directors may elect to incorporate one or more of the six RRP topics into their required programs of instruction for trainees. New faculty and staff may find the sessions a useful orientation to specific University of Michigan research policies and practices. Graduate students will learn about the practices and standards expected of professionals entering research-oriented careers" (50). Topics covered by the 1998–1999 RRP include introduction to responsibility in research (covering misconduct in science, institutional policies and guidelines, and other issues), authorship, mentorship, data management, protections for human and animal subjects, conflicts of interest, and lab safety.

The University of Minnesota is in the process of developing a web-based information and instruction program for its research activities. When complete, the program is intended to provide on-line access to all university policies, procedures, and guidelines on research, including policies on scientific misconduct, protection of human and animal subjects, informed consent, and guidance on roles and responsibilities of research administrators, principal investigators, and others (51). Some of the features that are intended to make the University of Minnesota program unique are on-line tutorials, such as a tutorial on obtaining informed consent, and brief instructions on particular issues or problems, such as how to process a potential conflict of interest or obtain approval for use of recombinant DNA. Tutorials are currently available or under development on the following topics: code of conduct, conflict of interest, effort certification, informed consent, and sponsored projects process. The latter is intended to be a map for preparing and managing sponsored projects, with access to forms, instructions, electronic tools, policies, and other information.

Defining Integrity Through Case Law

A variety of civil litigation cases have helped define how scientific misconduct and research integrity issues are decided. Whereas much of this litigation is targeted toward research institutions, individual scientists may also get involved either as plaintiff or defendant. Whether scientists are involved or not, these cases can affect how misconduct allegations or research integrity issues are applied to individual scientists and the scientific community.

Civil litigation filed under the False Claims Act (52, 53) authorizes the federal government, or private individuals suing on behalf of the federal government (called *qui tam* suits), to recover damages from institutions that make false claims in federal research grant applications submitted to funding agencies. Several of these suits have been filed, and others are pending under seal. *Qui tam* suits are initially filed under court seal to give the federal government time to assess whether it wishes to enter the suit and assume responsibility for the litigation.

In *United States ex rel. Berge* v. *University of Alabama* (54), the U.S. Court of Appeals reversed a jury verdict awarding $1.9 million in a *qui tam* suit brought by Dr. Pamela Berge against the University of Alabama-Birmingham (UAB) and four researchers. Dr. Berge conducted her dissertation research on cytomegalovirus at UAB while she was a graduate student at Cornell and subsequently filed suit against UAB and the researchers based on her claims that UAB and the researchers plagiarized the results of her research by using it without her permission and made false statements in grant applications and progress reports to NIH.

In reversing the jury verdict in Dr. Berge's favor, the court ruled that the alleged false statements in the grant applications and progress reports were not material to the NIH funding decision, and there was no plagiarism of Dr. Berge's work. The NIH program officer for the funding had testified that Dr. Berge's contributions were not central to the project, and the progress reported by UAB was satisfactory for continued funding without her contribution. ORI had previously decided not to pursue Dr. Berge's plagiarism complaint against the UAB researchers based on its policy that credit disputes between current or former collaborators do not constitute plagiarism under the PHS definition of scientific misconduct. This determination by ORI was noted by the court in its decision not to find plagiarism (54).

Another *qui tam* lawsuit, *United States ex rel. Condie* v. *University of California* (55), was settled before a jury verdict or court decision was rendered. This settlement resulted in a payment of $1.5 million by the University of Utah and the University of California, San Diego, to the United States and the *qui tam* plaintiff, Dr. Condie, for false claims in

grant applications and progress reports. The individually named defendant, Dr. Ninneman, also agreed to a three-year debarment from federal funding and to the retraction or correction of several scientific articles related to immunosuppression. Because there was no court decision in this case, *Condie* does not establish any formal legal precedent. However, it places individual researchers and research institutions on notice that scientific misconduct allegations can result in false claims covered by the Federal False Claims Act that may result in financial liability (56).

In *United States ex rel. Milam* v. *University of California* (57), the court dismissed a *qui tam* action against the university and individual scientist consistent with ORI's decision that there was insufficient evidence of falsification of data regarding brain tumor research to find scientific misconduct. The court ruled that the ORI report "is relevant and highly probative in that it is a detailed report, written by a scientific oversight agency, on the precise issue before the court" (57). The court also noted that "the level of intent required for ORI to proceed with an administrative action [an ORI finding of misconduct] is intentional falsification, a higher level of intent than that required under the False Claims Act. Because a claim could be actionable under the False Claims Act, and not actionable under ORI regulations, the issue is not identical" (57). Based on its review of all the evidence, including the ORI report, the court dismissed the case based on a motion for summary judgment. In reaching its conclusion, the court's opinion stated, "the Court is presented with a legitimate scientific dispute, not a fraud case. Disagreements over scientific methodology do not give rise to False Claims Act liability" (57).

In addition to the False Claims Act, other civil litigation has raised issues of interest to individual scientists. ORI and research institutions reviewing allegations of misconduct rely heavily on bench scientists to provide expert advice on investigations into alleged misconduct. These scientists often serve on committees of three to five members and participate in all aspects of the investigation including interviews, review of original data, lab notebooks, and manuscripts, and analysis of scientific questions. Scientists participate in these activities out of a sense of obligation to their colleagues and the scientific community, and their participation is crucial to the community's ability to identify and sanction proven scientific misconduct.

In a civil suit filed against the Baylor College of Medicine (BCM), *Angelides* v. *Baylor College of Medicine* (58), Dr. Angelides sued BCM and several of its employees in Texas State court seeking damages for several alleged torts arising out of his employment dismissal by Baylor. Dr. Angelides' claims included alleged defamation by BCM officials and committee members who investigated allegations of scientific misconduct by Dr. Angelides and reported their findings of misconduct to ORI. The case was removed to federal court.

After the defendant's attempt to have the case dismissed was rejected by the federal district court, and the case was returned to state court in 1996, ORI and HHS asked the Department of Justice to file an *amicus curiae* brief in the case, asserting the legal argument that the applicable federal statute and regulations require research institutions and staff to investigate and report alleged misconduct to ORI, thus shielding them from liability under state law. ORI relies on extramural institutions, and their scientists, to conduct over 90% of the investigations into alleged misconduct that occur under PHS research grants, cooperative agreements, and contracts. Exposing the institutions and scientists who assist in the investigations to legal liability for their actions would severely limit the ability of ORI and the scientific community to respond effectively to alleged scientific misconduct. In July 1997, the 5th Circuit Court of Appeals denied the appeal on jurisdictional grounds (59).The state court set a trial date for January 1999, but the case was settled and dismissed in early 1999 after the DAB upheld the ORI findings of misconduct against Dr. Angelides (60).

In other cases, whistleblowers who make their allegations of scientific misconduct public may expose themselves to potential legal liability for doing so. In one such case, Dr. Rosen, a scientist at the University of Maryland at Baltimore, was accused of scientific misconduct by Dr. Arroyo, and Dr. Arroyo's allegation was ultimately not sustained. Dr. Rosen sued Dr. Arroyo for defamation and invasion of privacy and was awarded a jury verdict of $75,001, which was upheld on appeal (61). In ruling in favor of Dr. Rosen, the Maryland Court of Appeals concluded that Dr. Arroyo had a qualified privilege to report her allegations of misconduct but violated that privilege by further disclosing the allegations after the University of Maryland investigation committee had exonerated Dr. Rosen of all charges (61). The court further concluded that disclosure of the allegation to the Baltimore Sun (which later published a story on the case) constituted an invasion of privacy (61). ORI has issued a memorandum advising whistleblowers of a qualified privilege that is available under most State laws for making good faith allegations of misconduct (62). However, the memorandum advises whistleblowers to limit disclosures to appropriate institutional officials and ORI to avoid potential legal liability for defamation, breach of confidentiality, or other civil claims.

In a second case involving a defamation suit against a whistleblower, *Shen* v. *Regents of the University of Minnesota* (63), the court dismissed the defamation and other claims made against the university and whistleblower on a motion for summary judgment. In dismissing the case, the court observed that a qualified privilege was most likely available to the defendant for making alleged defamatory statements to co-workers and former co-workers of the plaintiff, but did not make a final ruling on the issue because it determined that the alleged statements by the defendant did not constitute a claim of defamation (63).

One additional case is worthy of discussion. This case did not arise out of an allegation of misconduct *per se* but

involved the intentional destruction of Alpha 1-4 cells that interfered with a government research project. In *United States* v. *Arora* (64), a Maryland court ruled that Dr. Arora of the NIH must pay the U.S. Government $450 in compensatory damages, $5,000 in punitive damages, and costs of the civil suit for wrongfully destroying cells in a research project conducted by two other scientists. In ruling in the Government's favor, the court stated that Dr. Arora's actions "undermined the honor system that exists among the community of scientists, a system which is ultimately based on 'truthfulness, both as a moral imperative and as a fundamental operational principle in the scientific research process'" (64). This case demonstrates that, even when scientific misconduct is not found, scientists who violate the accepted norms of scientific behavior can be held accountable.

Conclusion

This article has surveyed the standards for research integrity that have been established through various mechanisms—definitions of misconduct adopted at federal and institutional levels and legal principles articulated through federal and state courts. Efforts to promote research integrity have also been discussed, primarily through education and training programs offered by research institutions and ORI. This information serves as a guidepost to bench scientists to avoid the most serious infractions of research integrity and a beacon to strive to the highest levels of good scientific practice. While the strides taken by research institutions and ORI in these areas have been significant in the past 10 years, the ultimate success of the scientific community in developing an effective response to misconduct and a commitment to the highest levels of research integrity depends on the individual decisions made and actions taken by working scientists.

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