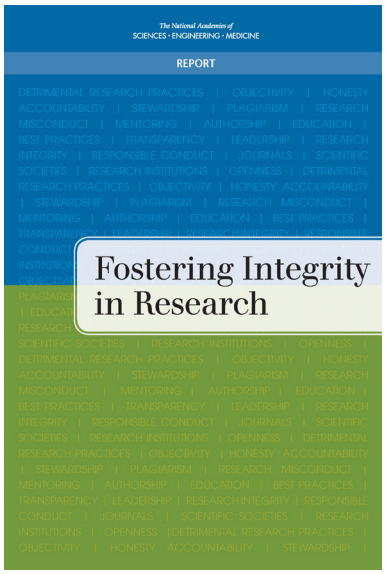
Report
HIGHLIGHTS
April 2017

Fostering Integrity in Research



The scientific research enterprise is a cornerstone of modern society. The U.S. public- and private-sector investment in research delivers enormous benefits to society in the form of better health, enhanced understanding of the natural world, and new technologies that boost economic growth and improve life in myriad ways. The integrity of knowledge that emerges from research is based on individual and collective adherence to core values of objectivity, honesty, openness, fairness, accountability, and stewardship.

Fostering Integrity in Research, a report from the National Academies of Sciences, Engineering, and Medicine, examines challenges to scientific integrity facing the research enterprise and recommends steps that individual scientists, research institutions, research sponsors, journal publishers, and professional societies should take to meet these challenges and better protect integrity in research. The report also recommends the establishment of an independent, nonprofit Research Integrity Advisory Board to support ongoing efforts to strengthen research integrity.

CHALLENGES TO INTEGRITY IN RESEARCH

Concerns about scientific research that have emerged in the scientific and general media over the past several years reinforce the need to rethink the strategies used to support integrity in research environments. A growing body of evidence indicates that substantial percentages of published results in some fields are not reproducible; this lack of reproducibility appears to have many causes, ranging from essential aspects of the research process or differences in procedures to research misconduct or detrimental research practices.

There also has been a remarkable increase in the number of retractions of journal articles, with analyses showing that a significant percentage of these retractions are due to research misconduct. The increase in retractions does not necessarily indicate that the incidence of misconduct is also increasing; other factors such as more vigilant scrutiny by the community and retractions becoming a more common practice among journals may be contributing factors. New forms of detrimental research practices are also appearing, such as “predatory” journals that do little or no editorial review or quality control of papers while also charging authors substantial fees.

In addition, the research environment continues to change in significant ways that affect efforts to foster research integrity. Longstanding trends include growth in the size and scope of the research enterprise, the expansion of regulatory requirements, and an increased emphasis on industry sponsorship and entrepreneurial research. In addition, several important newer trends have emerged, including the pervasive and growing importance of information technology in research, the globalization of research, the increasing relevance of knowledge generated in certain fields to policy issues and political debates, and a pervasive media environment that can help generate and spread findings and controversies. These changes have led to important shifts in the institutions that support and underlie the research enterprise.

While the research enterprise is not broken, it faces serious challenges in creating the appropriate conditions to foster and sustain the highest standards of integrity. To meet these challenges, deliberate steps must be taken to strengthen the self-correcting mechanisms that are an implicit part of research. The integrity of research depends on creating and maintaining a system and environment for research in which institutional arrangements, practices, policies, educational programs, and incentive structures support responsible conduct. The recommendations presented below are intended as a start to this process.

RECOMMENDATIONS

The report endorses the definition of scientific misconduct proposed in the 1992 Academies report *Responsible Science*: "fabrication, falsification, or plagiarism in proposing, performing, or reporting research." However, many practices that have until now been categorized as "questionable" research practices – for example, misleading use of statistics that falls short of falsification, and failure to retain research data -- should be recognized as "detrimental" research practices. Detrimental research practices should be understood to include not only actions of individual researchers but also irresponsible or abusive actions by research institutions and journals.

RECOMMENDATION ONE: To better align the realities of research with its values and ideals, all stakeholders in the research enterprise—researchers, research institutions, research sponsors, journals, and societies—should significantly improve and update their practices and policies to respond to the threats to research integrity identified in this report. Lack of attention to or tolerance of detrimental research practices by stakeholders makes it difficult to expose misconduct, wastes human and financial resources, impairs the overall quality of research, and diminishes public trust in science. The report offers checklists to form the basis of strategies to refine and implement best practices by researchers, research institutions, research sponsors, journals, and societies.

RECOMMENDATION TWO: Since research institutions play a central role in fostering research integrity and addressing current threats, they should maintain the highest standards for research conduct, going beyond simple compliance with federal regulations in undertaking research misconduct investigations and in other areas. The key responsibilities for research institutions fall into four areas:

- Creating and sustaining a research culture that fosters integrity and encourages adherence to best practices.
- Monitoring the integrity of research environments. Research organizations have an obligation to assess, monitor, and work to implement improvements to their research environments.
- Ensuring that research institutions sustain the capacity needed to effectively investigate and address allegations of research misconduct.
- Ensuring that senior institutional leaders, including the president, other senior executives, and faculty leaders, are guiding and actively engaged in the preceding three tasks.

RECOMMENDATION THREE: Research institutions and federal agencies should work to ensure that good-faith whistleblowers are protected and that their concerns are assessed and addressed in a fair, thorough, and timely manner. Those who raise concerns about the integrity of research, often referred to as whistleblowers, can play a critical role in supporting best practices in research and in uncovering research misconduct. But those who raise concerns are often the most vulnerable participants in the system, typically holding little institutional power or status. Research institutions and federal agencies should understand the implicit bias that exists against those who in good faith raise fact-based concerns about the integrity of research.

RECOMMENDATION FOUR: To provide a continuing organizational focus for fostering research integrity that cuts across disciplines and sectors, a Research Integrity Advisory Board (RIAB) should be established as an independent nonprofit organization. The RIAB will work with all stakeholders in the research enterprise—researchers, research institutions, research sponsors and regulators, journals, and scientific societies—to share expertise and approaches for addressing and minimizing research misconduct and detrimental research practices. The RIAB will also foster research integrity by stimulating efforts to assess research environments and improve practices and standards. The Research Integrity Advisory Board would bring a unified focus to understanding and addressing challenges across all disciplines and sectors. The RIAB will have no direct role in investigations, regulation, or accreditation. Rather, it will serve as a neutral resource based in the research enterprise that helps the enterprise respond to ongoing and future changes.

RECOMMENDATION FIVE: Societies and journals should develop clear disciplinary authorship standards. Standards should be based on the principle that those who have made a significant intellectual contribution are authors. Significant intellectual contributions can be made in the design or conceptualization of a study, the conduct of research, the analysis or interpretation of data, or the drafting or revising of a manuscript for intellectual content. Those who engage in these activities should be designated as authors of the reported work, and all authors should approve the final manuscript. In addition to specifying all authors, standards should (1) provide for the identification of one or more authors who assume responsibility for the entire work, (2) require disclosure of all author roles and contributions, and (3) specify that gift or honorary authorship, coercive authorship, ghost authorship, and omitting authors who have met the articulated standards are always unacceptable. Societies and journals should work expeditiously to develop such standards in disciplines that do not already have them. Authorship practices are a fundamental component of the research enterprise's operation, and observance of good practices is a key factor in ensuring research integrity. Authorship crucially designates who bears responsibility for the work. Clarifying authorship responsibility is also critical in cases of error or allegations of misconduct.

RECOMMENDATION SIX: Through their policies and through the development of supporting infrastructure, research sponsors and science, engineering, technology, and medical journal and book publishers should ensure that information sufficient for a person knowledgeable about the field and its techniques to reproduce reported results is made available at the time of publication or as soon as possible after publication. In many fields and disciplines, current standards for transparency are not adequately supporting reproducibility and the ability to build on previous work. The successful development and implementation of new standards and requirements will depend upon sufficient investments in necessary human and physical infrastructure.

RECOMMENDATION SEVEN: Federal funding agencies and other research sponsors should allocate sufficient funds to enable the long-term storage, archiving, and access of datasets and code necessary for the replication of published findings. Journals should update their publication requirements to include access to data and code needed to replicate results in the manuscript.

RECOMMENDATION EIGHT: To avoid unproductive duplication of research and to permit effective judgments on the statistical significance of findings, researchers should routinely disclose all statistical tests carried out, including negative findings. Research sponsors, research institutions, and journals should support and encourage this level of transparency. As routine reporting of negative results and statistical tests becomes the standard for all fields, research spending will become more productive, with more knowledge generated per dollar of research investment. Changing the culture of research and publication so that reporting negative results is required will depend on a persistent effort on the part of disciplines, sponsors, and journals.

RECOMMENDATION NINE: Government agencies and private foundations that support science, engineering, and medical research in the United States should fund research to quantify, and develop responses to, conditions in the research environment that may be linked to research misconduct and detrimental research practices. These research sponsors should use the data accumulated to monitor and modify existing policies and regulations. While understanding of the causes and incidence of research misconduct and detrimental research practices has increased, critical knowledge gaps remain. For example, official statistics on findings of research misconduct may represent a lower bound on incidence, with survey data pointing to a significantly higher incidence of misconduct, but no reliable estimate of incidence or trends exists.

RECOMMENDATION TEN: Researchers, research sponsors, and research institutions should continue to develop and assess more effective education and other programs that support the integrity of research. These improved programs should be widely adopted across disciplines and across national borders. Formal education and training in the responsible conduct of research (RCR) can play an important role in fostering integrity and strengthening research environments, but much remains to be learned about the approaches that are most effective. Evidence-based assessment and improvement of RCR education programs are needed, with the focus expanded to include the social and institutional environment for research.

RECOMMENDATION ELEVEN: Researchers, research institutions, and research sponsors that participate in and support international collaborations should leverage these partnerships to foster research integrity through mutual learning and sharing of best practices, including collaborative international research on research integrity. Given that research misconduct, detrimental research practices, and the need to foster research integrity are challenges facing all countries that fund and perform research, the global research enterprise will benefit from the knowledge gained from examining research practices globally

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