Best Practices for Responsible Conduct of Research – Life Sciences

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Abstract

Responsible Conduct of Research (RCR) is the practice of scientific investigation with integrity. It involves the awareness and application of established professional norms and ethical principles in the performance of all activities related to scientific research (NIH/ORI). According to the Retraction Watch Database, the majority of retracted scientific articles are linked to detrimental research practices and research misconduct; these may lead to wasted investment and career and reputational damage to those who engage in unethical conduct. RCR education provides the knowledge, skills, and resources needed to conduct science with integrity and prevent misconduct and detrimental research practices. Purdue is committed to fostering a culture of research integrity and implemented an RCR Standard (S20) that requires all faculty, staff, trainees, graduate and undergraduate students who design and conduct research and/or report and publish research outcomes to complete RCR training. Purdue has also developed RCR training resources, including a template for Lab Expectations – Life Sciences to facilitate researcher involvement in lab based plans for fostering research integrity and creating a safe, ethical, secure and productive research environment.

RCR Core Values and Guiding Norms

Honesty Convey information truthfully and honor commitments	**Accountability** Be responsible for and stand behind the work, statements, actions, and roles in the conduct of your work	**Stewardship** Ensure the long-term and sustainable care of research data and materials, from study design to data collection, analysis, storage, and sharing
Objectivity Let the facts speak for themselves and avoid improper bias	**Transparency** Declare interests and report all methods and data behind an analysis	**Fairness/Mentorship** Treat everyone fairly and with respect. Be responsible for the professional development of research trainees

Definitions

Research Integrity: involves using honest and verifiable methods in proposing, performing, and evaluating research, adhering to rules, regulations, guidelines, and professional codes or norms.

Detrimental Research Practices (DRPs): Actions that may threaten the integrity of research/researcher; but don't necessarily constitute fabrication, falsification, or plagiarism (FFP).

Research Misconduct: Fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.

Research misconduct **does not include honest error or differences of opinion**.

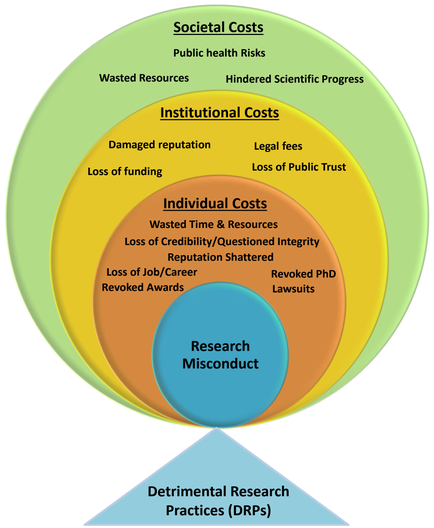
The Spectrum of Research Integrity

Responsible Conduct of Research	Detrimental Research Practices (DRPs)	Research Misconduct
Following ethical principles and professional standards throughout all stages of the research process, from proposing a study to reporting the results.	Examples: •Poor data management •Inadequate record-keeping •Undisclosed conflicts of interest •Biased data analysis •Overlooking ethical concerns in research design •Misrepresentation of qualifications/ experience •Misrepresentation of involvement in publications	• Fabrication (making up data) • Falsification (manipulating data) • Plagiarism (copying someone else's work)

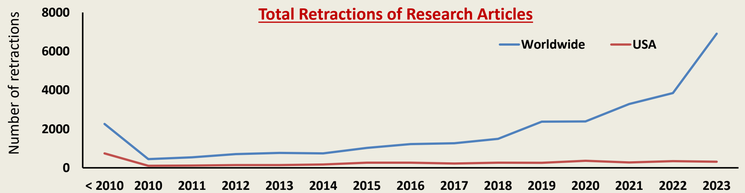
Ethical and rigorous research practices uphold the integrity of research.

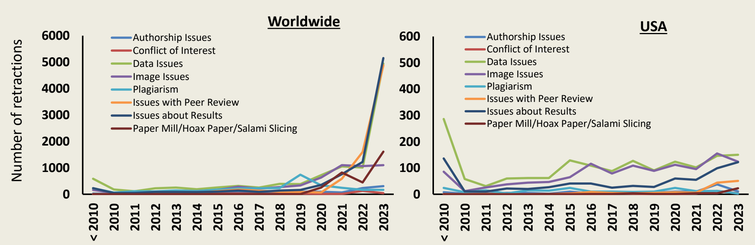
DRPs can create an environment that increases the risk of research misconduct

The Ripple Effect of Research Misconduct & Detrimental Research Practices (DRPs)



Retraction Trends: Number of Retractions by Year of Publication





The **Retraction Watch** database (RW DB) is the source of data for the figures above. It contains 28,850 retracted research articles from around the world (published between January 1927 to December 2023); 13% of these are from the United States of America (USA).

US Research Retractions (2010-2023):
A significant portion (75%) of retracted articles in the US stemmed from issues with data (41%) and image integrity (34%). Plagiarism of text (5%) and authorship concerns (3.5%) were less frequent reasons for retraction compared to data and image problems. Conflict of interest (1%) and concerns with peer review (4%) played a minor role in US retractions during this period.

Global Research Retractions (2010-2023):
Similar to the US, data (38%) and image concerns (20%) were top reasons for global retractions. Unlike the US, issues with peer review (29%) were more prominent globally, suggesting a potential need for strengthening peer review processes worldwide. Plagiarism of text (11%) and paper mills (11%) were also notable reasons for global retractions.

Examples of Image Manipulation

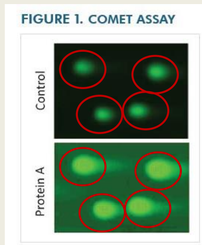


Fig. 1: The control image was cropped and relabeled as the image for Protein A. It was also intentionally lightened to make the "tails" appear longer.

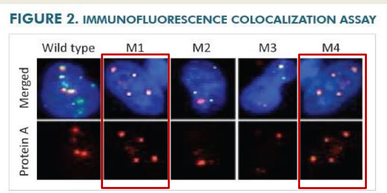


Fig. 2: M1 and M4 are the same image but Flipped vertically.

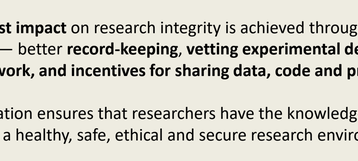


Fig. 3: The top panel and bottom panel of Figure 3 are from the same source image. The Protein A blot image has been flipped horizontally and represented as the control blot image.

Fig. 4: Lanes 1, 4, and 5 are from the same image source and were relabeled and reused to represent different experimental conditions.

Source: ORI

RCR Education and Resources at Purdue

Purdue is committed to the highest standards of research integrity and implemented the **Responsible Conduct of research (RCR) Standard (S20)** in 2020. It **requires all researchers** (faculty, staff, trainees/post docs, graduate and undergraduate students) who design and conduct research and/or report and publish research outcomes to complete RCR training tailored to their career stage and research field/area and has two components:

- **General RCR training** offered through the CITI online program
- **Field-specific RCR training** includes formal and informal PI- and Peer- led research group discussions, RCR workshops at the departmental and college level, case studies and ethics courses that are specific to particular discipline or research area.

Resources:
- EVPR RCR website
- Lab Expectations – Life Sciences Template; Engineering Template

Conclusions

- Research misconduct and DRPs jeopardize research integrity and public trust in the research enterprise
- Researchers must strive for the highest levels of ethics, honesty, and accuracy
- The **biggest impact** on research integrity is achieved through sustained **improvements in day-to-day research practices** — better **record-keeping**, **vetting experimental designs, techniques to reduce bias, rewards for rigorous work, and incentives for sharing data, code and protocols**. *Nature* 570, 5 (2019)
- RCR education ensures that researchers have the knowledge, skills, and necessary resources to conduct science in a healthy, safe, ethical and secure research environment.
- To ensure a **safe, ethical, secure and productive research environment,** each laboratory should maintain and periodically update a Lab Expectations document that outlines responsibilities of researchers for the specific research portfolio and lab rules for authorship, mentorship, and stewardship.