# Rigor and Reproducibility
# Instructor's Guide (ver. 2020.06.15)

**Michael Kalichman and Paul J. Mills**
**UC San Diego**

## Rationale

Societal benefits of research depend on the trustworthiness and reliability of that research. Unfortunately, recent years have been characterized by increased concerns about the high frequency of research that is not reproducible. In response to this challenge, the NIH and many others have called for better preparation of researchers to conduct rigorous and reproducible research. As one mechanism to promote training in reproducibility, the UC San Diego Altman Clinical and Translational Research Institute proposed the creation and testing of a two-hour workshop on this topic. These materials are the products of those efforts.

## Materials Included

1. INSTRUCTOR'S GUIDE — This document
   Included are sections covering Rationale, Materials Included (this section), Audience, Learning Objectives, Introductory Slides, Proposed Workshop Schedule, Comments on Assessment, and Resources for Instructors
2. INTRODUCTORY POWERPOINT SLIDES — Rigor and Reproducibility Introductory Slides.pptx
   Ten-minute introductory presentation
3. INTRODUCTORY VIDEO — To be completed
   Video of introductory presentation
4. WORKSHEET — Worksheet.docx
   For participants to list factors relevant to reproducibility of their research
5. SCORING RUBRIC — Scoresheet.docx
   For participants and/or instructor to assign factors to different categories relevant to the reproducibility of research
6. RESOURCES — Resources.docx
   List of resources for more information on reproducibility

## Audience

This workshop has now been successfully tested (Kalichman and Mills, accepted) with multiple audiences, consisting primarily of graduate students and postdoctoral researchers in a variety of disciplines (e.g., biology, biomedical sciences, physical sciences, and engineering). Participants have also included some faculty and staff, and the disciplines represented have occasionally extended to social sciences. By emphasizing principles of student-centered learning, it appears the approach translates to most if not all researchers and experimental disciplines.

## Learning objectives

The objectives defined for this workshop are that the participants will:

1. Better appreciate the wide range of ways in which reproducibility of research might be compromised.

2. Be able to identify a number of practices that might protect the reproducibility of your own research.

## Introductory Slides Rigor and Reproducibility Introductory Slides.pptx

These PowerPoint slides provide a framework for a 10-minute introduction to the topic of reproducibility. A recorded version of this lecture is in preparation. Each slide includes notes briefly summarizing points that might be made. Most instructors could readily use these slides, or something similar, to introduce the topic and the workshop.

## Proposed Workshop Schedule

This schedule is intended only as recommended timings for a workshop of about two hours. Flexibility should be allowed for differences in the instructor, audience, or particular issues that might be raised.

| Mins | Description |
|---|---|
| **2** | **Introduction:** Explain very generally the goals and purpose of the workshop.<br>Distribute Worksheet to all. |
| **8** | **Worksheet:** Ask participants to list issues that increase the risk that published work might be difficult to reproduce. At the end of this time, ask them to underline the last item on their lists. |
| **10** | **Introductory lecture:** PowerPoint slides |
| **25** | **Brainstorm**: Ask participants to identify groups of stakeholders that have a role in determining the likelihood that research will be reproducible. Some examples that may be identified include: individual researchers, the principal investigator (PI), the host institution, journals, editors, peer reviewers, professional societies, government funding agencies, suppliers of research materials, the public, the community of science, advocacy groups, industry, hiring committees, and the media.<br>**Group Assignments:** At end of brainstorming session, allow a few minutes to divide class into eight groups, each with a specific area of responsibility for identifying strategies to promote reproducible research. Instructor should choose up to eight areas from the Scoring Rubric (Scoresheet.docx). |
| **6** | **Group Discussions:** Ask groups to discuss and identify things that could be done to favor reproducible research in their respective areas of assigned focus. |
| **40** | **Discuss group results:** Ask each group to report back on one item from their list of possibilities for discussion with the instructor and other workshop participants. If <8 groups/topics, then supplement with discussion by everyone of other topics. If time permits, each group can contribute a second item for discussion. |
| **8** | **Worksheet:** Ask participants to write additional issues on their worksheet beneath the line demarcating items listed pre-workshop. |
| **10** | **Scoring:** When time is up for participants to add items to their lists, have them pair up to review their lists with each other and use the Scoring Rubric to determine how many items and categories each person identified pre-workshop, and then how many were added post-workshop. |
| **10** | **Summary and Closing:** Discuss results of scoring of worksheets (e.g., how many additional items, how many new categories), provide closing summary of key points learned, and ask participants to identify one or more things that they might pursue to increase the reproducibility of their work. |

## Comments on Assessment

The pre- and post-workshop assignment to list items on the worksheet is an opportunity to meet three different assessment goals:

1. Pedagogy: The pre-workshop assignment helps frame the issue as one that participants might not yet know well. The post-workshop assignment reinforces what was discussed in the workshop and helps to solidify awareness of things that they and their colleagues can do to promote reproducible research. The focus on student reflection on things that can be done to promote reproducible research ensures that the topic is approached from the perspective of their own experience.
2. Individual assessment: Identification of an increased number of items and/or number of categories represented can be used to assess the extent to which individuals have met the stated learning objectives.
3. Workshop assessment: These same outcomes can be used to assess the extent to which the workshop was effective in meeting the learning objectives for the participants.

All of the above can be tracked by determining if the post-workshop list, compared to the pre-workshop list, includes:

1. More factors relevant to the reproducibility of their research
2. More categories of factors relevant to the reproducibility of their research

Depending on the instructor's goals, the assessment exercise can simply be done by the students (and they retain their worksheets) or the worksheets can be handed in. If the former, then only the pedagogy goal would be met. If the latter, and if students put their names on their worksheet, then this would allow the instructor to assess (grade) each student's success in meeting course objectives. With or without their names, the collective results could be used to assess the impact of the workshop.

Whether there might a long-term impact of these workshops is an important question, but one which will require other methods for assessment.

## Resources


1. Brown PC, Roediger HL, and McDaniel MA (2014): Make It Stick: The Science of Successful Learning. Belknap Press
2. Kalichman M and Mills PJ (accepted): Workshop on Reproducibility in Research. Journal of Clinical and Translational Sciences.