

Advice on Rigor and Reproducibility in NIH Grants

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Significance

- Include bold headings of paragraphs with titles such as:
 - "Rigor of work demonstrating the importance of..."
 - "Rigor of data indicating that..."
 - "Rigor of work highlighting the importance of..."
- Focus on key data that must be solid for the proposed work to go forward.
- Consider adding a figure or two if they are essential to making your case to the reviewers, especially if this point was criticized in a previous submission.
- Consider adding a newly published figure if it's essential for the foundation of the work.
- Point out gaps in knowledge that you will fill.
- Try to keep this section to ~1.5 pages.

Approach

- Sprinkle comments such as these (with formatting for emphasis) throughout:
 - "*To ensure rigor and reproducibility*, we will..."
 - "*To rigorously test the hypothesis* that..., we will..."
- Can also include a general section such as this:
 - **Rigor and Reproducibility:** As specified for each experiment, we will use appropriate numbers of animals or human samples for all experiments, investigators will be blinded to treatment groups, and a statistician (first last, PhD) has worked with us on designing the experiments and will guide our data analyses.
- Provide sample sizes for all experiments, including animal experiments.
- Provide justification for the sample size (*a priori* power analysis or indication of the effect size you'll be able to detect).
- Include a solid "anticipated outcomes, potential challenges, and alternative approaches" section for each aim.
- Provide a strong statistical analysis section. If the analysis is unusual, go into more detail.
- Have a statistician read the grant and help with analysis section, and name that person on the grant.
- **Sex as a biological variable:** include this as a section heading even if the work is clearly only in one sex!

Review comments you do NOT want:

- There are gaps in clarity regarding the scientific premise underlying the proposed work that negatively impact enthusiasm.
- Despite overall enthusiasm for the line of investigation there are some gaps in presentation and analysis, particularly of the preliminary data in Figure 1 that are fundamental to the premise.
- After many cycles the evidence that XXX play a significant role in YYY remains to be provided.
- Sex as a biological variable was not mentioned.
- The application seems to suffer from extrapolation of literature in other XXX to the bench prior to ascertaining whether the experiments are biologically and physiologically relevant in the human YYY.
- There are limitations in the study design and the rigor of citing references that support the hypothesis.

Review comments you do want:

- Outstanding rigor and attention to power calculations in mice and human samples to detect statistically significant differences.
- Replicate experiments are proposed to increase rigor. Multiple complementary approaches are proposed.
- Power calculations and statistical analysis methods are stated, also increasing rigor.
- Reviewers noted the rigor of the prior research was built upon compelling preliminary data and numerous publications.
- Reviewers lauded the comprehensive and rigorously designed research plan.
- The development of the aims follows a solid rationale and are supported by strong preliminary data and recent publications from this laboratory.
- The scientific rigor of prior work is strong and justifies a new model...
- A strong case is made for the proposed model that....
- The rationale was well elaborated, and experiments were rigorously and logically designed, with necessary replicates, enough details of methodologies, and well-thought-out pitfalls, alternative strategy and data analysis plan.