Improving research reproducibility and reliability: progress update from symposium sponsors

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The Academy of Medical Sciences

BBSRC bioscience for the future

MRC Medical Research Council

wellcome

Introduction

The Academy of Medical Sciences, the Biotechnology and Biological Sciences Research Council (BBSRC), the Medical Research Council (MRC) and Wellcome jointly published the symposium report, 'Reproducibility and reliability of biomedical research: improving research practice', in October 2015.

The report highlighted the potential causes of irreproducibility and ways in which it might be addressed. Alongside the report, we published a statement promising to develop and implement changes to address the issue, and to publish, within 12 months, an update on our progress.

We are delighted to provide that update below. It outlines our key activities, alongside some additional commitments, to address the concerns about research reproducibility raised at the symposium.

We have also published an online version of this update: www.acmedsci.ac.uk/reproducibility-update/

Openness & Transparency

Greater openness and transparency of methods and data, and publication of null or negative results, is critical to help enhance reproducibility in scientific research. Furthermore, making research findings open access contributes to the reliability and robustness of research by making details of those findings freely available to be reproduced or challenged.

As funders, we support unrestricted access to the publication of research we fund, and encourage researchers to provide access to data and materials where possible. We are committed to working alongside key stakeholders, including journals, publishers and higher education institutions, to champion data sharing and open access.

Measures to make research findings and data accessible include Wellcome's new publishing platform, Wellcome Open Research, which has been developed with F1000Research. It allows Wellcome grant holders to rapidly publish all outputs from their research – from datasets to case reports, protocols, and null and negative results (including failed attempts at replication). Wellcome and the Research Councils have also worked with others to develop a Concordat on Open Research Data that sets out a series of clear and practical principles to help ensure that research data gathered and generated by members of the UK research community are made openly available for use by others wherever possible.

In addition, we all now:

- Set out clear expectations on data sharing and provide guidance on data management plans to our grant applicants.
- Require our researchers to make their original research papers open access, and provide funding or, alternatively, allow use of grant underspend to do so. We also either require or strongly encourage them to make their publications available through Europe PMC1. Europe PMC enhances its corpus of full text articles, PubMed abstracts, biological patents records and more, through integrating content with underlying text- and data-mining services, which improves discovery and facilitates interaction with the literature.
- Strongly support the use of the Creative Commons Attribution license (CC-BY), and either require or recommend that authors use it to license research papers, when we pay for open access, so they may be freely re-used.
- Encourage the use of ORCID for researchers to link to all their research activities.

* Our policies differ in that some funders require this as a condition of funding, while others strongly encourage it.

Research Design

Improving experimental design and the completeness of reporting is critical to reproducibility and the scientific validity of the results. As funders, we endorse existing guidelines such as the Animal Research: Reporting of In Vivo Experiments (ARRIVE) guidelines from the National Centre for the Replacement, Refinement, and Reduction of Animals in Research (NC3Rs).

We are keen to ensure better compliance with these guidelines and the MRC and Wellcome have contributed funding to an NC3Rs commissioned study into their impact. To encourage robust methodology, the MRC and BBSRC have also updated their guidelines on what information needs to be provided in research proposals involving animal use, with a much stronger emphasis on experimental design and statistics. Wellcome is in the process of reviewing the effectiveness of our policy and guidance on research involving animals and revising its good research practice policy to take into account the importance of statistics, experimental design and publishing negative and null results.

Attendees at the symposium discussed the lack of awareness around statistical power, the importance of appropriate sample size for the validity of findings and the need to address sources of bias in experimental design. To address this issue, we are all reviewing and updating relevant policies. We require rigorous experimental design especially in applications for research involving animals and encourage grant applicants working with animals to consider using the NC3Rs Experimental Design Assistant. This free online tool guides researchers through the design of their experiments, helping to ensure that they use the minimum number of animals consistent with their scientific objectives, methods to reduce subjective bias, and appropriate statistical analysis.

See also **funding decisions**

Funding Decisions

Funders play an important role in improving research standards via the peer review of funding applications. We are working with our peer reviewers and grant panel members to meet this challenge through for example:

- Collaboration with NC3Rs, who help us to peer review applications involving animals.
- Reviewing induction processes for grant panel members and Chairs. For example, MRC in collaboration with NC3Rs runs workshops on the importance of experimental design in animal work for new panel members from a range of funders (see also **research design**).
- The MRC now provides more space in grant applications for additional detail on experimental design and methodology, and has updated its guidance to applicants and reviewers, to ensure that these aspects of grant proposal can be effectively peer reviewed.
- The BBSRC has provided training for staff within their peer review teams to ensure appropriate handling of grant applications, regarding experimental design where animals are to be used.
- The Academy of Medical Sciences is reviewing the training needs of its sectional committee and grant panel members, and will develop appropriate training as needed.

We believe that it should be a priority of all funders to ensure that peer review panel chairs and members do not rely on journal impact factors as a measure of individual researchers' track record or the robustness of their work. We regularly review our induction processes and guidance and will continue to make this a priority with our grant and peer review panels.

Education & Training

As funders, it is a condition of our funding that research organisations provide researchers with appropriate training. Continuing education and training for individuals at all career levels is one way to improve experimental design, research methods, and statistical expertise.

As funders we require that PhD 'students should receive training in experimental design and statistics appropriate to their disciplines, and in the importance of ensuring research results are robust and reproducible.'

The BBSRC has recently funded an award to develop a five-day annual residential training course on robust research approaches, to be run with 30 students over three successive years. Feedback received from these courses will be used to develop e-learning materials.

We are collectively working to understand existing training provision and identify possible gaps through, for example, surveys of PhD students and graduate training leads to learn about their current training programmes and resource needs. We will continue to work together to find ways of sharing provision to minimise duplicated effort and train those funded by us, our staff and our grants and panel members most effectively.

Raising Awareness

Over the past year, we have sought opportunities to draw attention to the importance of research reproducibility, both within and outside the research community, and promote discussion of the issue amongst the research community.

All four funders have either increased web content or developed web pages dedicated to reproducibility, which include guidance on good practice and provide information about our activities and resources, such as cell banks and tissue banks (links provided below).

We have also been working to raise the international profile of the importance of this issue through various channels, such as the EuroScience Open Forum 2016, InterAcademy Partnership for Health and the Heads of International Research Organizations (HIROs). We are committed to being open about the issues related to research reproducibility in our external communications to inform discussion in the media.

We have set out some of the actions that we are undertaking to improve reproducibility. This is not an exhaustive list of all our activities – more information can be found on each of our websites, listed below. We know that other funders are also acting in this area. Irreproducibility is a system-wide issue that will require actions, not just from us, but also from publishers, research institutions and universities, researchers and the wider biomedical research community. We will continue working with others to address the issues related to reproducibility and will update our web pages with these ongoing activities.

Please visit:

Academy of Medical Sciences: http://www.acmedsci.ac.uk/policy/policy-projects/reproducibility-and-reliability-of-biomedical-research/

BBSRC: http://www.bbsrc.ac.uk/about/policies-standards/good-scientific-practice/

MRC: https://www.mrc.ac.uk/research/policies-and-guidance-for-researchers/

Wellcome: https://wellcome.ac.uk/what-we-do/our-work/research-practice