



Science Advancement & Outreach
A DIVISION OF PETA

1536 16th St. N.W., Washington, DC 20036

NIH Request for Information: Measuring and Rewarding Scientific Impact
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Rigor and Reproducibility. Reproducible and replicable biomedical approaches are foundational to rigorous research. New strategies are needed to identify areas ripe for replication and reproducibility efforts, as well as incentives and infrastructure to support the reproduction and replication of existing findings.

Experiments on animals have long been recognized as a major contributor to the reproducibility crisis in biomedical research. Former NIH leadership acknowledged that "[p]reclinical research, especially work that uses animal models, seems to be the area that is currently most susceptible to reproducibility issues" (<https://doi.org/10.1038/505612a>).

In addition to the harms inflicted on animals and poor translation, irreproducible experiments impose substantial costs on science and the public. Failed attempts to replicate findings can consume years of effort and millions of dollars while delaying the development of effective interventions. Importantly, irreproducibility is an indicator that certain approaches are not generating sufficiently reliable knowledge to justify continued investment.

NIH must prioritize metrics that identify, evaluate, and replace methods that fail to produce reproducible, translatable, and clinically meaningful results.

NIH should establish dedicated funding mechanisms for evidence synthesis and comparative assessments of research methods, such as that which can be generated through systematic reviews. Systematic reviews can assess whether methods are scientifically valid, translatable, and relevant to human biology (<https://brill.com/edcollbook-oa/title/35072>; https://ntp.niehs.nih.gov/sites/default/files/2024-03/VWG_Report_27Feb2024_FD_508.pdf; <https://doi.org/10.1177/01410768221093551>).

Extensive data already exist without the need to reproduce every experiment at the benchtop. Researchers who identify ineffective approaches and facilitate their replacement should be recognized and rewarded for these important scientific contributions.

Reproducibility is also influenced by the quality and consistency of the biological reagents used in research. Antibodies and cell culture media can be significant sources of experimental variability when they are derived from irreproducible sources or are poorly characterized. NIH should support efforts to improve the adoption and characterization of reliable research reagents, including sequence-defined non-animal recombinant antibodies and chemically-defined cell culture media. NIH already recognizes the importance of this issue through its requirements that grant applicants address the authentication of key biological and chemical resources used in

proposed research. However, beyond requiring researchers to describe authentication plans, NIH should establish targeted funding opportunities, incentives, and reporting metrics that promote the development, validation, characterization, and adoption of more reliable reagents. Measurable indicators could include increased funding and use of sequence-defined antibodies and chemically-defined cell culture medium.

Data, Software, and Model Sharing. *Sharing scientific data and tools accelerates biomedical research discovery, in part, by enabling validation of research results, providing accessibility to high-value datasets, and promoting data reuse for future research studies. NIH seeks to incentivize and reward these activities to maximize the value of research investments, catalyze collaborations, and accelerate scientific impact.*

In addition to the sharing of data and software, NIH should reward investigators and institutions for sharing information that enables the scientific community to identify superior research approaches and discontinue ineffective ones. This could include creating databases that catalog human-based research methods, sharing data on the predictive performance and validation of human-based models, or developing data, tissue, cell, and other model-related repositories that facilitate the replacement of experiments on animals. NIH's Standardized Organoid Modeling Center is an excellent start, and efforts like this must be expanded for other human-based technologies.

NIH should incentivize the creation of openly accessible resources that help researchers identify and adopt non-animal methods. Making data on model performance publicly available would enable more informed funding decisions, facilitate meta-research, and accelerate the replacement of experiments on animals, which fail to advance human health.

Training and Mentorship. *NIH recognizes that advancing its mission requires promoting the growth and stability of the biomedical research workforce. While NIH supports training and protects time through existing policies and programs, additional indicators are needed to assess and quantify the impact of these efforts.*

NIH should reward mentors and institutions that prepare researchers to use the most rigorous, reproducible, and human-relevant approaches available. Metrics such as publication output and grant success do not assess whether trainees are equipped to advance biomedical research using methods that are predictive of human biology.

NIH should incentivize training programs that support the development and adoption of non-animal methods, including organoids, organs-on-chips, computational models, artificial intelligence tools, and other human-based approaches. Indicators of successful training and mentorship could include participation in cross-disciplinary programs, acquisition of skills in emerging technologies, and transition from experiments on animals to human-based methods. Mentors who help trainees critically evaluate the strengths and limitations of existing research methods should also be recognized for advancing scientific rigor and training future scientists in the important discipline of meta-research. Likewise, institutions should receive credit for

providing researchers with the knowledge, infrastructure, and support needed to replace experiments on animals with modern human-based approaches.

As part of efforts to build institutional capacity, NIH should support educational opportunities for individuals involved in research oversight, including Institutional Animal Care and Use Committee (IACUC) members. Online training programs focused on non-animal methods, emerging human-relevant technologies, and the scientific and regulatory limitations of animal models would help to better equip IACUCs to evaluate animal use proposals in light of available non-animal methods and advances in biomedical science.

NIH should also support retraining opportunities for established investigators whose careers have been built around animal experimentation. Providing scientists with the resources and incentives needed to adopt human-relevant methods would strengthen the biomedical workforce and accelerate the transition away from experiments on animals.

For more information on this topic, see “Developing a global education hub for animal-free innovation,” by Janssens et al. (<https://doi.org/10.14573/altex.2411251>).

Collaboration. *As biomedical research becomes increasingly interdisciplinary and convergent, collaboration is growing in both scale and complexity. NIH seeks new approaches for assessing and recognizing contributions to team-based science.*

Replacing experiments on animals will be most successful when we combine expertise that spans multiple disciplines, including cell biology, omics, bioengineering, materials science, computational biology, data science, and artificial intelligence. Advances such as organoids, organs-on-chips, digital twins, and AI-enabled drug discovery depend on the integration of knowledge, tools, and datasets across these fields. NIH should therefore recognize and reward collaborative projects that bring together diverse scientific expertise to further develop and apply human-based approaches. Particular recognition should be given to collaborative efforts that generate shared resources or produce evidence demonstrating that human-based methods can replace experiments on animals and facilitate the transition away from them.

Entrepreneurship and Translation. *To advance the translation of discoveries into products for people, NIH fosters the maturation of discoveries from bench to bedside and promotes innovation across sectors. More can be done to incentivize, assess, and integrate the impact of innovation and entrepreneurial efforts as critical to the NIH mission.*

Translation should be measured by whether a research approach improves prediction of human outcomes.

Drug candidates typically progress through a development pipeline in which experiments on animals remain the norm. Basic and translational research often involve animal experiments, the most commonly used models of human disease are not human, and preclinical development has historically required extensive animal testing. The result of this status quo has been 95% of novel

drugs failing in clinical trials (<https://ncats.nih.gov/research/research-activities/ntu>). After decades of dependence on animal use, such a failure rate cannot reasonably be described as a successful translational paradigm. The failure of this system to deliver translational impact, and the need for it to change, are clear.

Entrepreneurial and translational impact should be assessed based on the development, validation, and adoption of better methods that improve the prediction of human responses. Researchers, institutions, and companies that develop approaches capable of replacing experiments on animals should be recognized for advancing more effective pathways from discovery to clinical application. NIH should also reward innovations that reduce the cost, time, and high attrition rates that have long stymied drug development.

Foundational Scientific Exploration. Basic research and high-risk, high-reward initiatives represent foundational scientific exploration with an inherent risk of failure but the potential for paradigm-shifting breakthroughs. Further embedding these approaches within the academic enterprise is essential to ensuring continued support for bold and innovative research directions.

Human-based technologies such as organoids, organs-on-chips, advanced imaging, computational modeling, and AI are enabling researchers to study human biology directly, capture patient-specific variation, and answer questions that experiments on animals cannot. These approaches have the potential to transform basic research itself by providing unprecedented insight into human development, disease, and physiology and should be prioritized when considering foundational research applications.

Expanding the scientific community's ability to study human biology directly should also be recognized as a paradigm-shifting contribution to basic research and the biomedical research enterprise. NIH should therefore consider projects that develop, improve, or apply these technologies as essential to foundational scientific exploration. Scientific impact should be measured not only by discoveries made using existing research tools, but also by the creation of new capabilities that expand what biomedical research can achieve.

Public Impact. NIH seeks approaches for assessing and recognizing the broader public impact of biomedical research, including contributions to health outcomes, economic growth, clinical practice, public trust, accessibility, and societal benefit.

Public impact should include transparency, accountability, and alignment with public expectations regarding how taxpayer-funded research is conducted. The public reasonably expects that federally funded research adheres to the public's views on morality, uses the most scientifically advanced approaches available, and that research investments are regularly evaluated to ensure they continue to serve the public interest. In terms of the public's views on morality, opposition to the use of animals in experiments has increased steadily. In 2026, Gallup reported that only 45% of Americans felt that medical testing on animals was morally acceptable, down from 65% in 2001 (<https://news.gallup.com/poll/710981/moral-acceptability->

falls-several-behaviors.aspx; <https://news.gallup.com/opinion/polling-matters/694550/trends-adults-acceptance-moral-values-behaviors.aspx>).

NIH must recognize that improving public impact requires discontinuing practices that no longer meet scientific and ethical standards. Research that identifies areas where experiments on animals can be ended and provides evidence-based pathways for modernization can help ensure that public funds are directed toward approaches most likely to benefit human health.

NIH should also recognize efforts to increase transparency regarding the methods it funds and the outcomes those methods produce. This should include public reporting on research portfolios, assessments of the scientific value and human relevance of funded approaches, and measures of progress toward reducing experiments on animals, including quantitative tracking of the number of animals used in NIH-supported research and the purposes for which they are used.

Public impact should also encompass activities that increase public confidence in the biomedical research enterprise. Scientists who openly evaluate the strengths and limitations of existing research methods, engage with public concerns, and/or facilitate the transition from experiments on animals to human-based methods provide a valuable service to both science and society.

A meaningful indicator of public impact would be whether NIH-funded research becomes more transparent, more accountable to taxpayers, and more responsive to scientific advances. Efforts to replace experiments on animals with modern human-based approaches can advance all three goals by aligning research practices with both scientific progress and growing public expectations.

Other Areas.

Animal methods bias occurs when research is judged less favorably because it does not include animal experiments, regardless of whether animal use is scientifically necessary. As human-based approaches such as organoids, organs-on-chips, computational models, and AI become increasingly capable of addressing biomedical research questions, researchers continue to report pressure from reviewers, funders, and mentors to conduct experiments on animals to secure funding.

Animal methods bias can distort scientific evaluation by conflating the inclusion of animal experiments with rigor, validity, or translational relevance. A research method should be assessed based on its fitness for purpose and ability to answer the research question at hand, not on its familiarity or historical prominence. Bias toward animal use may disadvantage innovative human-based approaches and discourage researchers from pursuing methods that are directly relevant to human biology.

NIH should recognize animal methods bias as a potential barrier to scientific progress and research modernization. Understanding the extent to which bias influences peer review, funding decisions, publication outcomes, and career advancement would help ensure that researchers are rewarded for scientific merit and impact rather than adherence to established methodologies.

Mitigating animal methods bias would support innovation, accelerate the adoption of human-relevant approaches, and better align research incentives with NIH's goal of advancing rigorous and impactful science. On this matter, NIH should consult the Coalition to Illuminate and Address Animal Methods Bias (www.animalmethodsbias.org).