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Meeting Report

Exploring animal methods bias in biomedical research funding: Workshop proceedings and action steps

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ABSTRACT

New approach methodologies (NAMs) and other nonanimal methods are increasingly effective and available to researchers for modeling human biology and disease, but barriers to their broader adoption remain. One such barrier is animal methods bias: a type of peer review bias characterized by a preference for animal-based research methods or lack of expertise to properly evaluate nonanimal methods, which affects the fair consideration of animal-free approaches. Existing evidence demonstrates that animal methods bias can affect the likelihood and timeliness of animal-free studies being accepted for publication, and anecdotes indicate that it can impact the review of applications for funding too. To assess this latter phenomenon further, the Coalition to Illuminate and Address Animal Methods Bias hosted a virtual interactive workshop in May 2024 to explore (1) how animal methods bias affects the review of grant proposals and subsequent funding rates for researchers who use nonanimal methods and (2) possible solutions for biomedical researchers and funders to mitigate these effects. Researchers, funders, peer review bias scholars, and research policy professionals gathered to synthesize current knowledge and gaps, scholarship and personal perspectives on peer review bias, and funding contexts regarding the prioritization and assessment of nonanimal research. Here, we present workshop proceedings and action steps aimed at addressing animal methods bias in funding. Possible mitigation measures include promoting the value of NAMs among the scientific community, implementing bias mitigation training, ensuring review groups have proper expertise to adequately evaluate NAMs proposals, and investing in NAMs initiatives and infrastructure.

1. Introduction

Animal methods bias is a type of peer review bias in which a preference for animal-based research methods or lack of expertise to adequately evaluate nonanimal methods affects the quality or fairness of nonanimal research assessments. In manuscript peer review, this bias is characterized by reviewers or editors expecting or requesting that animal experiments be included in studies, sometimes as a condition for publication (Krebs et al., 2023). This bias can delay publication or force authors to publish in lower impact journals, effectively disincentivizing nonanimal research approaches, or it can lead researchers to conduct animal experiments that might otherwise be avoided (Krebs et al., 2023a). There is anecdotal evidence that animal methods bias can also negatively impact the review of grant applications (Krebs et al., 2023b).

Human-specific nonanimal methods, also sometimes termed novel alternative methods or new approach methodologies (NAMs), are increasingly being developed and used to reduce and replace the use of animals in research and testing—in line with the near global adoption of the 3Rs principles (replacement, reduction, and refinement; Russell and Burch, 1959). NAMs include complex *in vitro* systems derived from human cells, *in silico* models, and *in chemico* screening platforms (NIH Complement Animal Research in Experimentation (Complement-ARIE), 2024). Advances over the last decade have made these methods a preferred choice for many researchers for a variety of reasons. They can reliably mimic human biology and clinical responses, provide a more reliable translation of preclinical findings into safe and effective treatments (Ingber, 2022; Loewa et al., 2023), and avoid the ethical and emotional burden associated with experimenting on animals (Beauchamp and DeGrazia, 2020; LaFollette et al., 2020). As such, there are increasing efforts among researchers, policymakers, and regulators to advance the development and use of these approaches to improve biomedical translation and reduce and replace the use of animals in science (Chang et al., 2023; European Parliament, 2010; Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM) Validation Workgroup, 2024).

Despite the availability of these methods in many applications, confidence is still being established (van der Zalm et al., 2022) and uptake has been slow due to a variety of barriers (Busek et al., 2022; Moruzzi et al., 2023). Many researchers still perceive animal use as the "gold standard" in biomedical research and testing (Ingber, 2020), which can lead to unfair assessments of nonanimal studies or unjustified requests for animal experiments (for example, to validate findings derived from *in vitro* methods). If animal methods bias affects the fairness of peer review for nonanimal grant proposals, it could impact funding rates for these technologies and have formidable policy implications for biomedical research funders aiming to bolster their use.

The Coalition to Illuminate and Address Animal Methods Bias (COLAAB) is an international collaboration of researchers and advocates formed in 2022 to develop strategies to address this phenomenon. Although animal methods bias has likely impacted research assessments

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for many years, the concept has only recently been described. In 2024, the COLAAB won the Lush Prize Recognition Award for Major Science Collaboration for its work on this issue, primarily in the arena of research assessments for publication. In May 2024, the COLAAB expanded its efforts by hosting a virtual workshop to explore how animal methods bias may affect the assessment of grant proposals and subsequent funding rates for researchers who use nonanimal methods. This report provides an overview of current knowledge about animal methods bias, presents the use of the workshop as a format for gathering stakeholder perspectives on animal methods bias in funding, and synthesizes action steps emerging from the workshop aimed at addressing this barrier to the broader use of NAMs and other nonanimal biomedical research approaches.

2. Animal methods bias in biomedical research assessments

2.1. Animal methods bias in publishing assessments

In 2020, organ chip pioneer Donald E. Ingber published an overview of advances in organ chip technologies framed in the context of reviewer requests for animal experiments, making the case that it is time for reviewers to start requesting human organ chip validation experiments instead of animal ones (Ingber, 2020). This represented the first public account (to our knowledge) of animal methods bias, which at the time, had not been named. Because publishing plays a crucial role in the advancement of science, helping to translate biomedical findings from bench to bedside, in addition to progressing researchers' careers, researchers are heavily incentivized to comply with editor and reviewer expectations and requests—even if they do not necessarily agree with them (Rawat and Meena, 2014; Receveur et al. 2024). At this pivotal juncture, noncompliance with such expectations and requests could impact the likelihood of a study being published, with multiple tangential consequences. Thus, in contrast to *publication bias*, which the Catalog of Bias defines as "when the likelihood of a study being published is affected by the findings of the study" (namely, negative or low magnitude findings) (DeVito and Goldacre, 2019), *animal methods bias in publishing* can be defined as a preference for animal-based methods or lack of expertise to properly evaluate nonanimal methods, which results in the unfair assessment of nonanimal research and affects the likelihood or timeliness of a manuscript being accepted for publication.

In 2023, Krebs and colleagues reported the first ever empirical evidence of animal methods bias in publishing: a survey that assessed the experiences and perceptions of authors and reviewers related to animal- and nonanimal-based experiments during peer review (Study 1) (Krebs et al., 2023b). Twenty-one (31 %) of 68 survey respondents indicated that they had performed animal-based experiments for the sole purpose of anticipating reviewer requests for them—as in, outside of the context of review, they did not think the experiments were necessary. Thirty-one (46 %) respondents indicated that they had been asked by reviewers to add an animal-based experiment to a study that otherwise had no animal experiments. When asked whether they thought the request for the addition of animal experimental data was justified, of those 31 people, only three indicated that they felt the request was justified, while 14 indicated that it was sometimes justified and 11 indicated that it was not justified. Krebs and colleagues recently replicated these findings in a larger and more representative sample: 31 (16 %) of 189 respondents used animals for the sole purpose of anticipating requests for them; 98 (52 %) had been asked to add animal experiments to their otherwise nonanimal study and chose to comply only 21 % of the time (Study 2, unpublished results). When asked to elaborate on their answers, respondents said:

- "Referees ask for animal experiments because it is customary, not because it is necessary. Many are unaware about the potential of *in vitro* and *in silico* methods." (Study 1)
- "In my experience, reviewers on grant panels are even more likely to ask for animal experiments than manuscript reviewers." (Study 1)
- "When applying for grants related to ischemic stroke injury using *in vitro* models, reviewers on several occasions emphasized the limitations of the model while requesting the inclusion of an animal model into the study design." (Study 2)
- "I was recently told in a grant review critique that a weakness of my study was lack of an animal model." (Study 2)

Even when not prompted to comment specifically on their experiences during grant review, researchers describe *animal methods bias in funding*—one respondent even going as far to say that it is more of an issue than animal methods bias in publishing. It is possible that animal methods bias could impact any scenario where research is being assessed.

2.2. Animal methods bias in funding assessments

The US National Institutes of Health (NIH) is the largest funder of biomedical research in the world but has been slow in demonstrating explicit support for nonanimal methods. A recent study found that, although the use of nonanimal methods is increasing, growth has been slower in the US and China compared to the UK, France, and Germany (Taylor et al., 2024). The authors hypothesized that lower rates of nonanimal methods use in the US and China may be due to a lack of or delay in regulatory drivers pushing their use, which have been implemented in other countries.

In 2022, the NIH convened a working group tasked with reviewing the state of nonanimal methods and suggesting high-priority areas for where and how they can be implemented (NIH Advisory Committee to the Director, 2022). In its final report of recommendations, the working group acknowledged that reviewers may lack awareness and knowledge of nonanimal methods and suggested that the ability to properly evaluate them could be a barrier to the broader development and use of these methods (Chang et al., 2023). Specifically, the working group issued a recommendation for the NIH to "Promote training for grant reviewers to better understand how to evaluate the use of NAMs in fundamental and applied research grants."

Although there are no published studies that provide empirical evidence of animal methods bias in funding, a recently completed pilot study may provide some insights. An analysis by Trunnell and Roe focused on NIH funding of grants for basic, translational, and preclinical neuroscience research—an area in which the persistent use of animal models has been critiqued as contributing to slow progress in the field. They examined whether peer reviewer's own methods expertise might influence the methods used in funded grants by the agency (Trunnell and Roe, 2023).

NIH grant review is conducted by more than 200 review groups called study sections, composed of peers who are prior NIH grant recipients (or, in the case of the Early Career Reviewer program, have at least applied for an NIH grant). Trunnell and Roe identified 23 study sections charged with the review of basic, translational, and preclinical neuroscience grant applications and the 432 reviewers who sit on these panels. They assessed methods expertise of reviewers using iCite, an NIH tool that provides bibliometric data on an individuals' peer-reviewed papers based on the fraction of Medical Subject Heading (MeSH) terms, which are used for categorizing and searching biomedical information, included in the paper. Their results indicated that the grant reviewers on these 23 study sections predominantly held expertise in animal-based methods. The balance of expertise across study sections was 43 % animal, 22 % human, and 33 % molecular/cellular (E. Trunnell and K. Roe, unpublished results).

Using publicly available data, Trunnell and Roe then assessed the methods used in 562 funded grants scored by these study sections over an eight-month period. 454 (81 %) of the grants proposed animal methods either alone or with other methods while only 149 (26 %) of

grants used nonanimal methods alone or in combination with other methods (E. Trunnell and K. Roe, unpublished results). Linear regression analysis suggested that having individuals with animal-based expertise on grant review committees was highly positively correlated with funding of animal-based grants and negatively correlated with funding for nonanimal methods, providing the first evidence to date of animal methods bias in funding. Information on unfunded grants is neither publicly released by the NIH nor available through public records requests, highlighting the need for transparency and further study to determine whether funding rates for different methods are also impacted by submission rates and to assess the arguments used by reviewers or advisory committees when proposals are given a low score or declined funding, respectively.

To build the case for further empirical study of how animal methods bias may affect research funding, the COLAAB convened a workshop for stakeholders. The aim of this workshop was to: understand what is currently known and unknown about animal methods bias in funding and in the context of research on other biases; allow individuals to share personal experiences with peer review bias; and suggest strategies for measuring and mitigating animal methods bias in biomedical research funding. The results of this workshop are presented here.

3. Workshop format

On May 16, 2024, the COLAAB hosted a four-hour interactive virtual "Workshop to Explore Animal Methods Bias in Biomedical Research Funding" via Zoom meeting. The meeting was open to the public (although registration was required) and was promoted on social media and via relevant listservs. Including hosts, presenters, and panelists, 158 people in total registered for the event, and 79 attended. Attendees included biomedical researchers, funders, peer review bias scholars, and research policy professionals gathered to carry out the following charge:

1. Gather broad stakeholder perspectives, including from:
   a. Researchers, especially NAMs developers and users;
   b. Funders, public and private across various global regions;
   c. Scholars of peer review bias; and
   d. Advocates, lawmakers, and other agents of change;
2. Characterize animal methods bias in funding, including:
   a. Current evidence and evidence needs;
   b. Its impact on research, innovation, health outcomes, and researchers' careers; and
   c. Parallels with animal methods bias in publishing and other contexts in which research is evaluated; and
3. Identify potential solutions, both individual and structural.

The workshop agenda is described in Table 1. It began with an interactive poll via Slido, which asked the following questions:

1. Why are you here today? (Open-ended)
2. Where are you joining us from? (Open-ended)
3. What is your area of work? (Choices included: basic/applied research, regulatory, education, communication, research funding, research policy, and other)
4. In your opinion, how much of a barrier is animal methods bias in funding to the broader acceptance and use of nonanimal research approaches? (Score between 1 and 5)

Following the poll, Catharine E. Krebs provided an overview of animal methods bias and the work of the COLAAB, describing the rationale for the workshop and its charge, after which Emily R. Trunnell presented a pilot study on animal methods bias in NIH grant funding. Information from these presentations is summarized in Section 2 of this report.

The first stakeholder perspective-gathering session then proceeded on the topic of scholarship and personal perspectives on peer review bias. Panelists for this session were selected based on their expertise in nonanimal research approaches (Chandrasekera, Geissler, Hedtrich, and Raha), or their expertise in grant peer review (Langfeldt). After a short break, the second stakeholder perspective-gathering session proceeded on the topic of the role of funders in addressing animal methods bias. Panelists for this session were selected based on their current role at research funding organizations (Nolte, de Waard, and Kandaras) or former role at the EU Reference Laboratory for alternatives to animal testing (EURL ECVAM; Pistollato). For both sessions, panelists were provided with questions for discussion ahead of the workshop to get them acquainted with the topics at hand (see Supplementary materials). They each were offered five minutes to provide a personal background and perspective, followed by a discussion with the larger group, at which time anyone in attendance could ask a question or offer input (via chat or by unmuting).

The workshop included a 30-min breakout session where participants were split into two groups to further elaborate their experiences and perspectives on animal methods bias in funding. The Whiteboard

Table 1
Workshop agenda.

Topic	Duration	Presenter/ Panelist	Title, Affiliation
Introductory poll	5 min		
Animal methods bias and the COLAAB	15 min	Catharine E. Krebs, PhD†,*	Medical Research Program Manager, Physicians Committee for Responsible Medicine
Animal Methods Bias in NIH Grant Funding? A Pilot Study	15 min	Emily R. Trunnell, PhD†,*	Director, Science Advancement and Outreach, People for the Ethical Treatment of Animals
Scholarship and personal perspectives on peer review bias	60 min	Charu Chandrasekera, PhD‡	Executive Director, Canadian Centre for Alternatives to Animal Methods, University of Windsor
		Dr. Sven Geissler‡	Principal Investigator, Berlin Institute of Health, Center for Regenerative Therapies, Charité Universitätsmedizin Berlin
		Prof. Dr. Sarah Hedtrich‡	Associate Professor, Berlin Institute of Health, Charité Universitätsmedizin Berlin
		Sandeep Raha, PhD‡	Principal Investigator, Faculty of Health Sciences, Department of Pediatrics, McMaster University
		Prof. Liv Langfeldt‡	Research Professor, Nordic Institute for Studies in Innovation Research and Education
Break	5 min		
The role of funders in addressing animal methods bias	60 min	Dr. Martijn Nolte‡	Senior Program Manager, ZonMw, The Netherlands
		Bas de Waard, MSc‡	Policy Officer, Transition Programme for animal-free Innovation (TPI)
		Kenneth Kandaras, JD‡	President, International Foundation of Ethical Research
		Francesca Pistollato, PhD‡,*	Senior Strategist, Humane Society International
Break	10 min		
Interactive brainstorming session	60 min		
Concluding poll	5 min		
Wrap-up	5 min		

† Presenter.
‡ Panelist.
* COLAAB member.

tool on Zoom was used for collaborative editing, allowing participants to brainstorm and share their ideas and experiences before coming back to the full group for discussion. The Whiteboard was set up with the following questions to prompt the breakout groups:

1. Briefly describe your personal experience with animal methods bias in funding (if applicable).
2. What are some ways to make NAMs proposals more competitive?
3. In which research and disease areas do you think animal methods bias is more common?
4. How might animal methods bias interact with other biases or scientist characteristics (e.g., seniority, institution)?
5. How does this issue differ across global regions?
6. What are the most pressing evidence needs? How can evidence be gathered? How can buy-in from funders be generated?
7. What are the most promising mitigation measures?

The workshop concluded with another Slido poll, which asked the following questions:

1. In your opinion, how much of a barrier is animal methods bias in funding to the broader acceptance and use of nonanimal research approaches? (Score between 1 and 5)
2. Rank these according to what you think is the best first step to addressing animal methods bias in funding. Choices included:
   a. Ensuring expertise in method types is balanced on review committees
   b. Implementing nonanimal-specific funding streams
   c. Gathering more evidence of the problem
   d. Implementing translatability/human relevance review criteria
   e. Developing reviewer guidelines
   f. Developing reviewer training modules
3. What topics or ideas that we did not discuss today (or that we did not discuss enough today) should we prioritize for future meetings? (Open-ended)

Summaries of the stakeholder perspective-gathering sessions, interactive brainstorming, and polls are provided below, along with a synthesis of themes and recommendations that emerged throughout the workshop. While the workshop aimed to gather diverse perspectives from a broad group of stakeholders, a fully representative range of views, interests, and concerns was not articulated. Accordingly, this report does not seek to make generalized statements about opinions in biomedical research, but rather aims to explore this topic in a preliminary manner, on which future, more comprehensive studies can build.

4. Workshop findings

4.1. Scholarship and personal perspectives on peer review bias

The first presentation was by Charu Chandrasekera. She described submitting a proposal to the Canadian Institutes of Health Research (CIHR) for a five-year project to develop and validate a multicellular 3D bioprinted alveolar tissue model for use in toxicity testing and disease modeling. Chandrasekera described receiving a comment from one reviewer indicating that the main weakness was the proposed model itself, while another stated that animal toxicity data would be required to justify a five-year grant. Chandrasekera noted that many of her colleagues can relate similar stories and are frequently asked to validate human biology-based data as if it were merely anecdotal. She was eventually able to secure alternative funding to develop and validate the human alveolar microphysiological system. This is capable of measuring aspects such as human plasma Cmax (which is not possible in an animal model unless enormous doses are used) within two to five days, and the project has already conferred one MSc degree and formed the foundation for a doctoral degree. The team is preparing to submit the findings to a high-profile journal, but Chandrasekera expressed fears that the work will not be reviewed fairly. She believes the onus for addressing animal methods bias is on funding agencies and journals, and that things will only change with a strong top-down approach. Funding agencies must stop downplaying the value of human biology and data, she said.

Sven Geissler spoke next about his team's work on prognostic biomarkers and targeted therapies for musculoskeletal regeneration. Their research focuses on the development of novel diagnostic and therapeutic strategies, and their translation into clinical practice. He emphasized that the history of medicine indicates that many of the greatest breakthroughs have resulted from direct studies of patients. Thus, his work begins and ends in the clinic, where he examines patient data and analyzes corresponding biopsies to identify the underlying healing problems in humans. In addition to these patient-centered studies, he highlighted that in-depth basic research is crucial for developing effective therapies. This foundational work is essential to uncover the underlying molecular and cellular mechanisms using appropriate experimental models. While animal experiments are frequently used to investigate these mechanisms, he pointed out a common pitfall: Reviewers of grant applications are often unaware that animals do not fully replicate patient characteristics. For Geissler's team, the translational route is circular: even if they have been able to successfully test their findings in clinical studies, they return to the laboratory to understand why some patients do not respond and how the therapy can be improved. He suggested emphasizing in grant applications that the ultimate aim is to treat humans, not mice.

The next panelist, Sandeep Raha, works in the field of reproductive toxicology and fetal programming, studying how environmental insults affect the process of placentation and fetal development. In 2018, he applied to the CIHR for funds to develop an organ chip model of the human placenta. He described being told that he would need to demonstrate validity using an animal model, even though, as he said, there is no good animal model of human placentation and human reproductive signaling. Raha believes there is some apprehension within the Canadian context about using NAMs. Students coming up through graduate and undergraduate programs have been exposed to animal models but not NAMs; consequently, they lack confidence in NAMs and are reluctant to use them. Furthermore, Raha observed that few people realize how flexible NAMs are. Funding agencies acknowledge the importance of studying sex as a variable, for example, yet few researchers understand that this is possible using *in vitro* models. Educating the next generation, therefore, is critical, said Raha, if people are to grasp the value of NAMs. Another participant added that educating more established researchers about the value of NAMs is also important.

Sarah Hedtrich was the fourth panelist. Her view was that obtaining funding for NAMs is easier in Europe and Germany, where NAMs are more widely recognized, than it is in Canada. Nevertheless, she said she was able to obtain funding from CIHR, despite colleagues saying this would be impossible without an animal model. She feels that funding agencies are acknowledging the value of and pushing for NAMs more and that things have changed for the better; 15 years ago, for example, it was difficult to obtain funding for NAMs or publish NAMs studies in high impact journals without an animal model, but now there are papers in *Science* or *Nature* that rely entirely on NAMs. Hedtrich said she still receives comments about the need to demonstrate her findings in animal models but has found that if she makes a strong case about why an animal model is unnecessary, this is often accepted by reviewers and editors. She emphasized the importance of checking what type of expertise reviewers on funding panels have and making decisions about where to seek funding accordingly. She also said that she receives many enthusiastic student applications to join her lab because they do not want to work on animals.

The final panelist, Liv Langfeldt, presented her research on trust and

bias in the peer review process. She noted that different types of bias exist and that variation in peer assessments may be due to the reviewer's field of expertise, their competencies and experience, but also their personal and research agendas. Peer reviewers are expected to use perspectives from their field, she said, but they are not supposed to let their research interests influence the review. Similarly, while it is not necessarily wrong to have a scholarly bias, personal bias is unacceptable and represents a conflict of interest. In general, it is better to have a reviewer that is scholarly close to you than a non-matching reviewer, she said, because the latter will seldom fight for your grant on a panel.

One of Langfeldt's studies found that panels with less stringent decision procedures enabled panel members to negotiate and fight for their favourites (Langfeldt, 2022). These panels allowed room for randomness, scholarly pluralism, and nonconventional research, although at the same time there was less transparency, fairness, and predictability. Conversely, on panels with stricter procedures there was less pluralism, less randomness, and more conservative outcomes. On panels with a large budget and a rating scale of only four scores, applications would frequently end up with the same score, allowing negotiation and more wide-ranging discussion. However, if a panel had a tight budget and a fine rating scale, there would be less discussion and less room for randomness.

In terms of gathering evidence of bias, Langfeldt noted that it would be useful to find out whether proposals using animal methods are more successful in obtaining funding than proposals that do not use animal methods. To help mitigate animal methods bias, she suggested pushing for greater transparency, encouraging funders to enable rebuttals, or trying to change the system from within by getting onto funding panels or working as a Scientific Review Officer at the NIH (or the equivalent role at other funders, coordinating and overseeing review groups). She said the next generation must take power to overcome existing power distributions which uphold the status quo.

At the end of this session, speakers were asked to discuss whether similar levels of rigor are expected of animal and nonanimal studies, and whether NAMs are associated with additional costs. Chandrasekera began by arguing that animal studies are not conducted to high standards and are not held to the same rigor as NAM studies. She suggested that scientists using animals should have to justify how their research will be relevant to humans. Geissler agreed that scientists using animals are not typically required to prove how well their models mimic the human situation; rather, they are primarily questioned about which *type* of animal model to use, with animal use being taken for granted. In contrast, researchers using NAMs face the challenge of convincing reviewers that their approaches are as valuable as an animal experiment *and* effectively mimic human biology. Geissler also stated that the technology his team uses is more expensive than mice, although in the long run the approach is cheaper because the failure rate is so much lower. This advantage, he suggested, could be compellingly argued in grant applications.

While agreeing that NAMs scientists are held to a higher standard, Hedtrich noted that it was nevertheless critical to validate the predictivity of human models. In terms of costs, she said she could buy 20 mice for €200, the price she pays for just one bottle of media. Raha observed that in the field of reproductive biology, scientists use animal models even though they fail to mimic the human situation, and they show no sign of gravitating away from these irrelevant models. He agreed with others that the costs of developing NAMs are high. He also noted that in Canada, there is only one panel he can submit funding proposals to for reproductive biology and that it is stacked with clinicians who may not have experience with NAMs. Chandrasekera also mentioned that Canadian funders lack the breadth of the US and EU making it harder to find a review panel with appropriate expertise.

Geissler stated that scientists conducting animal experiments can simply order some animals and get on with their research, whereas *in vitro* approaches take time to get going, which can be a problem if funding is only for three or four years. Even just establishing an organoid at the beginning of an experiment is time consuming, he said. Furthermore, he noted that working with patients requires a lot of time and flexibility, something that can make a funding proposal vulnerable to critique. Chandrasekera suggested developing a plan to help the younger generation, stating that her graduate students deserve to work in labs like Ingber's, where they can conduct research using organoids, 3D printed tissue, computational modeling and so on. She stated that funding decisions should be based on the rigor and translatability of the science, as well as its impact and return on investment, especially in the context of public funding. She also said that it is important to mobilize the public; demonstrating this engagement can contribute to changes in research systems.

Attendee Laura Langan, from the Arnold School of Public Health, University of South Carolina, observed that in the US context, reviewers in early career stages can only join funding panels if they have already submitted a grant. This means the reviewer pool, consisting primarily of mid- to late-career researchers may be more conservative, she said, and less inclined to support novel methodologies, especially if those methodologies challenge research they have pursued throughout their careers. Funding panels could be opened up, she suggested, to bring in new ideas and energy; for example, graduate or postdoctoral students who are developing innovative methodologies, who know their area well and who have already published several papers, could be invited onto panels to offer their opinions and perspective, perhaps participating in decision-making the second time they sit on the panel.

4.2. The role of funders in addressing animal methods bias

Martijn Nolte opened the session; he is a senior program manager at ZonMw, the Dutch equivalent of the US National Institutes of Health, which provides funding for knowledge and innovation in health, healthcare and well-being. Since 2000, ZonMw has been stimulating alternatives to animal testing, which is currently focused in their program "More Knowledge with Fewer Animals" (ZonMw, 2023). Through this dedicated program, ZonMw aims to advance the development, acceptance and implementation of nonanimal approaches. In this context, they fund nonanimal research, connect parties, encourage the use of nonanimal approaches in practice, encourage more effective use of results derived from animal experimentation (for example, by funding systematic reviews or supporting the publication of negative data), and support NAMs validation activities. Regarding animal methods bias, Nolte acknowledged its likely existence within review panels but noted that its prominence is uncertain and likely more prevalent among external experts. The extent to which it represents a concrete problem is still unclear. However, the current funding landscape for NAMs in the Netherlands has improved significantly compared to ten or 15 years ago. Additionally, if any reviewer requests animal experimentation, the ZonMw review panels are advised to override such requests. To gather evidence of animal methods bias, Nolte suggested that large language models could be utilized to evaluate reviewers' reports. To address animal methods bias, he emphasized the need to (1) raise awareness among reviewers and panel members; (2) formulate guidelines for evaluators; and (3) ensure the inclusion of NAM experts on review panels. Ultimately, research methods should be fit for purpose and selected based on the research questions.

The second panelist was Bas de Waard, a policy officer for the Transition Program for animal-free Innovation (TPI) in the Netherlands and 3Rs (replacement, reduction, and refinement of animals used in research and testing) policy, collaborating with different organizations to support this transition. De Waard and his team support the development and phase in of nonanimal methods, with the goal to make use of the best models that are available to support better prediction and with the ambition to make the Netherlands a catalyst of the international transition towards animal-free innovation. TPI supports the development and implementation of NAMs; catalyzes the EU transition towards nonanimal approaches by working on a policy instrument so this topic

can be covered in the EU agenda; and promotes dissemination, dialogue, and networking. In addition, they contribute to the creation of research infrastructures. De Waard and his team support the TPI program and the 3Rs with open science initiatives (e.g., preregistration) and explore ways to phase out specific animal tests.

The third panelist was Kenneth Kandaras, president of the International Foundation of Ethical Research (IFER), which supports research efforts aimed at replacing or reducing the use of animals in testing and primarily focuses on providing financial support to post-graduate students whose mentors have already accepted their research proposals and are already aligned with their mission. IFER follows a two-stage process to evaluate proposals: pre-proposals are evaluated by eleven members of the scientific advisory board, and when considered successful, they invite proponents to submit full proposals. Over several decades, they have extended 50 graduate fellowships. Currently, each fellow receives $15,000 per year, along with the opportunity to apply for a $1000 travel grant. Unlike other funders in the US, there are no geographical restrictions. This year, they received 53 pre-proposals and expect to fund six or seven of them. They recently conducted a survey to address the issue of animal methods bias, targeting 32 former IFER fellows. Eleven responded, and 71 % indicated that the review process favors animal testing. Additionally, 71 % refused to include animal data when during the manuscript review process, they were asked for animal experimental data to be added to a study that otherwise had no animal-based experiments. IFER plans to expand this scoping analysis to better understand the prevalence of animal methods bias.

The last panelist of this second session was Francesca Pistollato, a senior strategist at Humane Society International and former contract agent at the EU Reference Laboratory for alternatives to animal testing. Pistollato commented on the importance of understanding several key aspects related to methods bias in research grant assessments, particularly animal methods bias. These include: (1) the prevalence of methods bias in general and animal methods bias specifically and what funding bodies can do to mitigate or prevent such issues; (2) which research areas are most affected by this problem; (3) the selection procedures and the criteria used to identify project reviewers, such as their background, expertise, and other criteria; and (4) potential regional differences in the occurrence of animal methods bias. She highlighted the San Francisco Declaration on Research Assessment (DORA) and the Coalition for Advancing Research Assessment (CoARA) as efforts to ensure fair research assessments increasingly being endorsed by individuals, organizations, and funders around the world (Coalition for Advancing Research Assessment, 2022; Declaration on Research Assessment, 2012; European Research Council, 2021). Scholarly bias, methodological bias, nor animal methods bias are specifically mentioned in these efforts, but Pistollato argued that the biases that are mentioned could help explain animal methods bias. For example, *status quo bias* is defined as "the tendency to take the path of least resistance unless there are strong reasons not to," which may lead reviewers to favor familiar, albeit flawed, methodologies rather than embracing novel ones, due to the perceived effort in change (Hatch and Schmidt, 2020). In addition, *availability bias*, defined as "anecdotal, top-of-mind, or easily recalled data can inadvertently skew what we prioritize," could result in overlooking the value of innovative approaches by giving undue weight to readily available information about traditional animal methods (Hatch and Schmidt, 2020).

Finally, Pistollato proposed some strategies that could be considered to mitigate some of these biases, in particular, (1) increasing multidisciplinarity and involving evaluators of project proposals with expertise in NAMs; (2) implementing criteria for assessment of models' and methods' translatability (e.g., those outlined in the Framework to Identify Models of Disease (FIMD) (Ferreira et al., 2019)); (3) identifying and implementing indicators for retrospective assessment of research impact, considering the role of methods selection in the generation of impact, for example, as done in the context of recent EU Joint Research Centre activities (Deceuninck et al., 2024; Gastaldello et al., 2023); and (4) implementing double-blind review of research proposals.

Following the brief panelist presentations, a discussion ensued, providing panelists and other attendees with an opportunity to further express their views and elaborate on the topics at hand. A key question raised was how researchers can prevent animal methods bias and ensure fair reviews in the evaluation of research proposals. Attendee Lena Smirnova of the Center for Alternatives to Animal Testing at Johns Hopkins University emphasized the importance of increasing the presence of researchers with expertise in nonanimal methods on review panels, as well as the necessity of scrutinizing animal study justifications more rigorously. She suggested seeking out funding opportunities and calls for proposals that specifically focus on NAMs, highlighting that organizations like the NIH and the European Commission (EC) have specific requests for applications (or calls for proposals) tailored to these methods. Examples include the recent NIH Complement-ARIE Program (NIH Common Fund, 2024) and the recent EC call on Innovative non-animal human-based tools and strategies for biomedical research (European Commission, 2023).

Nolte noted that researchers should make clear and compelling arguments for the use of their chosen models, ensuring that these models are well-suited to answer their research questions. Agreeing with this, de Waard emphasized that this includes placing the chosen models within the broader context of available tools and advocating for their appropriateness. Chandrasekera argued that despite providing strong rationales, researchers may still face biases, underscoring the need for policy solutions and global agreements. In particular, the concept of the 3Rs was discussed, with some viewing it as merely a box-ticking exercise that varies by region, such as between the EU and Canada. She encouraged researchers to challenge biases and advocate for fair evaluation practices.

Krebs provided updates on advocacy efforts of the COLAAB, which wields its international cross-sector member base to advocate for change. The coalition recently submitted two comments to the NIH advocating for measures to help better understand and mitigate animal methods bias: one to the Center for Scientific Review (CSR) Advisory Council meeting (NIH Center for Scientific Review, 2024a) and another in response to requests for information about publishing bias (NIH National Institute of Neurological Disorders and Stroke, 2024). She also reiterated recent progress at the NIH. The Advisory Committee to the Director working group on NAMs published a report in December 2023 (Chang et al., 2023). Accepted by the agency in February (Bertagnolli, 2024), the report includes recommendations for NIH investment in NAMs, focusing on infrastructure and training. The report highlighted the need for reviewers to be properly equipped to evaluate NAM-based proposals, implicitly acknowledging that current reviewers may lack the necessary expertise, which in turn presents a barrier to the broader development and use of these methods.

In response to COLAAB comments about animal methods bias, CSR clarified that they cannot train reviewers how to score the science. In other words, reviewers cannot be tasked with prioritizing certain kinds of research; such prioritization must come from strategic plans and funding opportunities. However, funding opportunity announcements can specify review criteria, such as a proposed project's human relevance or translatability. Since August 2021, CSR has implemented a bias mitigation training required for all grant reviewers and scientific review officers (NIH Center for Scientific Review, 2024b). This training initially focused on biases related to applicants' gender, race, or institutional affiliation, using vignettes and videos to help reviewers recognize and address bias by intervening on review panels. CSR has also implemented mechanisms for reporting instances of bias during grant reviews. Over the next three years, the training will include a vignette on scientific bias—the preference for one's own science or approach (NIH Center for Scientific Review, 2022)—a positive step toward mitigating methods biases in grant evaluation, including animal methods bias.

While training reviewers on how to evaluate particular types of research may be impractical, NIH's Complement-ARIE program intends

to hold voluntary education and outreach to the scientific community regarding the value of NAMs. Along with efforts to raise awareness among reviewers about scientific bias, the NIH can begin to address animal methods bias in funding assessments. Krebs asserted that other funding bodies should explore similar mitigation steps. In addition, attendees emphasized the importance of expanding NAMs expertise on review panels, potentially through the development databases consisting of NAMs researchers upon whom review coordinators can call.

There was interest in whether the NIH (or other major funders) would be willing to conduct studies of animal methods bias. The study section analysis described above highlights the value of information on unfunded grants, which is protected and difficult for meta-researchers to access. Previous studies on NIH funding bias, primarily focusing on race, career stage, and other demographics, were acknowledged (Ginther et al., 2011; Hoppe et al., 2019; Lauer et al., 2021). Attendees questioned how to convince funders that animal methods bias is an important and impactful bias that deserves attention. Building strong evidence through surveys of researchers or reviewers was highlighted as essential to moving beyond anecdotal evidence and proposing concrete actions. In addition, access to NIH review data (especially unfunded proposals) for an in-depth assessment was seen as a crucial future step. Leveraging the movement towards greater transparency in research, including animal research, was proposed as a strategy when approaching funders.

In summary, this second session underscored the need for increased expertise in NAMs on review panels, requirements for the rigorous justification for animal studies, proactive advocacy and policy solutions, and strong evidence that can be used to identify and mitigate animal methods bias. Transparency and advocacy were seen as key components in driving change and ensuring fair assessment of nonanimal research.

4.3. Breakout group discussions for in-depth brainstorming and synthesis

Results of the Whiteboard brainstorms are available in the Supplementary materials. In summary, participants reported personal experiences with animal methods bias, as well as anecdotal experiences from direct colleagues, such as difficulties in securing funding for NAMs research in liver disease or the imposition of mouse model requirements for a NAM-based study in fish toxicology. When asked for strategies to enhance the competitiveness of NAMs-based proposals, participants suggested several key approaches. These included providing a robust justification for the use of *in vitro* models to answer a specific research question, by clearly contextualizing them within the landscape of existing models and presenting validated evidence, ideally corroborated by multiple laboratories. It was noted that a comprehensive section of the grant proposal should be dedicated to explaining the rationale for selecting NAMs, supported by an extensive literature review, preferably systematic, to establish the suitability of the chosen models. Whenever possible, human data should be incorporated for validation.

Diverging opinions emerged on how to position NAMs in the proposal. One viewpoint emphasized the challenges associated with traditional biomedical animal models, such as reproducibility issues and inconsistencies in experimental outcomes (often with wide margins of response for the same experiments), underscoring the potential of NAMs to bridge the gap between animal and human responses. Conversely, some suggested avoiding direct confrontation with existing animal methods, which might provoke defensive attitudes among reviewers. Instead, NAMs should be presented as innovative tools that advance scientific knowledge rather than merely replicating previous animal studies for validation.

Regarding the research areas where animal methods bias is most prevalent, participants identified fields such as cancer, cardiovascular disease, regulatory drug development, endocrinology, immunology, and neuroscience. There was a consensus that animal methods bias affects a wide range of disciplines, particularly those involving human disease research, due to the historical reliance on animal-based datasets. It was suggested that further research is needed to document and understand the specific areas and mechanisms where animal methods bias is most pronounced.

Participants also discussed the intersection of animal methods bias with other biases and researcher characteristics. It was noted that senior researchers might be more susceptible to bias due to their established positions, while early-career researchers may face greater scrutiny and challenges when proposing novel methods. Finding a principal investigator supportive of NAMs can be a challenge for early-career researchers in several biomedical fields. The lack of institutional support for NAMs, particularly in fields where animal facilities are well-established and readily funded, was also highlighted as a significant barrier. Participants suggested that providing funding for the establishment of *in vitro* centers could facilitate the broader adoption of NAMs by ensuring the necessary infrastructure is available.

The discussion also touched on regional differences in animal methods bias. It was generally agreed that animal methods bias seems less of an issue within the EU, possibly due to the availability of NAMs-specific funding streams. However, disparities were noted even within the EU, with some countries lagging in NAMs adoption, while others, like the Netherlands, are perceived as leaders. In contrast, limited funding in countries like Brazil was cited as a major obstacle to the development and implementation of NAMs, despite strong awareness of NAMs in that country. In Canada, a lack of NAMs expertise among reviewers (and thus fewer specialized review panels with lower scholarly diversity) has led to adverse funding outcomes for NAMs researchers. In the US, toxicology researchers were seen as more aware of NAMs compared to those in other disciplines. Given that the NIH is the largest funder of biomedical research in the world, participants emphasized the importance of NIH leadership in improving NAMs reviews to set a standard for other funding agencies.

Obtaining evidence of animal methods bias was recognized as a challenging but critical task. Participants proposed large-scale, anonymous surveys of researchers and grant reviewers from various funding bodies as a method to gather data on animal methods bias. Additionally, it was suggested that collaboration with meta-researchers in other fields could provide insights into accessing funding review reports, potentially through semi-open reviews or under non-disclosure agreements. Understanding the reasons behind unsuccessful NAMs-based proposals, particularly from major entities like NIH, could reveal how much of the issue lies in proposal framing or a lack of NAMs expertise among reviewers. There was broad agreement that promoting semi-open review processes and ensuring diverse expertise on review panels are essential steps toward addressing animal methods bias.

In addition to increased transparency in the grant review process, participants proposed several mitigation strategies. These included the establishment of NAMs-specific funding streams, particularly in research areas with low NAMs adoption, and the inclusion of multidisciplinary NAMs expertise on review panels, encompassing various NAMs such as *in chemico, in silico*, and *in vitro* models. Raising awareness of animal methods bias and equipping researchers with the necessary tools to prepare competitive NAMs-based proposals were also identified as crucial steps in mitigating animal methods bias.

4.4. Participant polling

At the opening and closing of the workshop, participants were polled as described above. The Supplementary materials provide a complete view of the polling responses, which are summarized here. Workshop participants joined from areas across North America and Europe (n = 34), with Germany being the most well-represented country. Participants from a variety of sectors were present, including basic/applied research (29 %), research policy (26 %), education (20 %), regulatory (17 %), research funding (14 %), communication (6 %), and “other” (26 %) (n = 35). The reasons participants gave for joining the workshop included their interest in learning more about animal methods bias—including its prevalence, how to prevent or mitigate it in their own

work, and how it impacts scientific advancement—and their interest in nonanimal methods and joining in discussions with others who use and develop them.

Participants were polled both before and after the presentations and discussions on their opinions regarding the extent to which animal methods bias in funding is a barrier to the broader acceptance and use of nonanimal research approaches (Fig. 1). None of the participants felt that animal methods bias represented no or little barrier to the broader acceptance and use of nonanimal research approaches. Though explicit conclusions are limited by the small sample size and change in sample size between the two polls, respondents rated animal methods bias as more of a barrier at the end of the workshop, compared to the beginning, indicating a possible shift in opinions based on the proceedings of the workshop and personal testimonies. It is also possible that participants who already saw animal methods bias as a high barrier at the beginning of the workshop were more likely to have stayed for its entirety to participate in the closing polls.

Participants were also asked what they thought was the best first step to addressing animal methods bias in funding. Respondents felt that ensuring that expertise in method types is balanced on review committees and implementing nonanimal-specific funding streams were the most important first steps, followed by gathering more evidence of the problem, implementing translatability/human relevance criteria in grant review, and developing guidelines and training modules for grant reviewers ($n = 11$). When asked what topics participants would like to see prioritized in future meetings, respondents felt that community building and public awareness around this issue is needed, as was the assemblance of additional evidence, fostering acceptance of nonanimal methods in regulations, stronger oversight practices, and the exploration of animal methods bias in other research assessment contexts, such as hiring and tenure ($n = 8$).

5. Discussion and conclusions

Biomedical research stakeholders have a keen interest in understanding and addressing peer review biases—to ensure that the scientific record is fair and accurate, that the most rigorous and impactful science is funded, and that personal preferences are accounted for, among other reasons. While not explicitly describing peer review bias related to the evaluation of NAMs, the recently convened NIH working group on NAMs described the need for reviewers to understand the unique value of NAMs in order for their successful deployment and use (Chang et al., 2023). If reviewers fail to understand the value of submissions that propose to use NAMs, it may affect their ability to impartially interpret quality and impact. NAMs are an emerging technology, and many reviewers may not be trained in their methodological details or aware of their advantages. Nevertheless, the inability to remain impartial toward NAMs would constitute peer review bias (Lee et al., 2012) and may impede the successful catalysis of NAMs at the NIH and elsewhere. Thus, it is important to understand and address animal methods bias—a version of peer review bias—to ensure that NAMs and other nonanimal methods are evaluated fairly and successfully deployed and used.

The workshop described herein aimed to explore animal methods bias in funding assessments, with the goal of informing future work to gather more empirical evidence and mitigate its harmful effects on researchers and the research ecosystem. Panelists and participants from across North America and Europe and from a variety of sectors joined in the discussion. In the opening session, panelists shared first-hand accounts of animal methods bias experienced in grant reviews. Anecdotal descriptions of reviewer comments revealed an insistence on employing animal-based methods for the validation of *in vitro* findings (even when such methods did not exist), rejection of the proposed NAM-based model outright, and preference for animal-derived data over more clinically relevant patient-based research. The panelists' collective experiences were dominated by the hesitancy of certain reviewers to embrace animal-free technology despite growing evidence of the poor clinical transition of animal studies. This hesitancy can partially be explained by poor awareness of the value of NAMs, underscoring the need for future efforts to establish the translational relevance and value of NAMs in the scientific community, especially among early career researchers. There was some optimism with the observation that funding channels are becoming more accessible in regions where NAMs are gaining more traction. It was mentioned that, in the long run, NAMs are more efficient and economical than animal studies as they exhibit superior clinical transition rates—although initially requiring more investment to establish. Solutions that were offered and discussed are summarized in

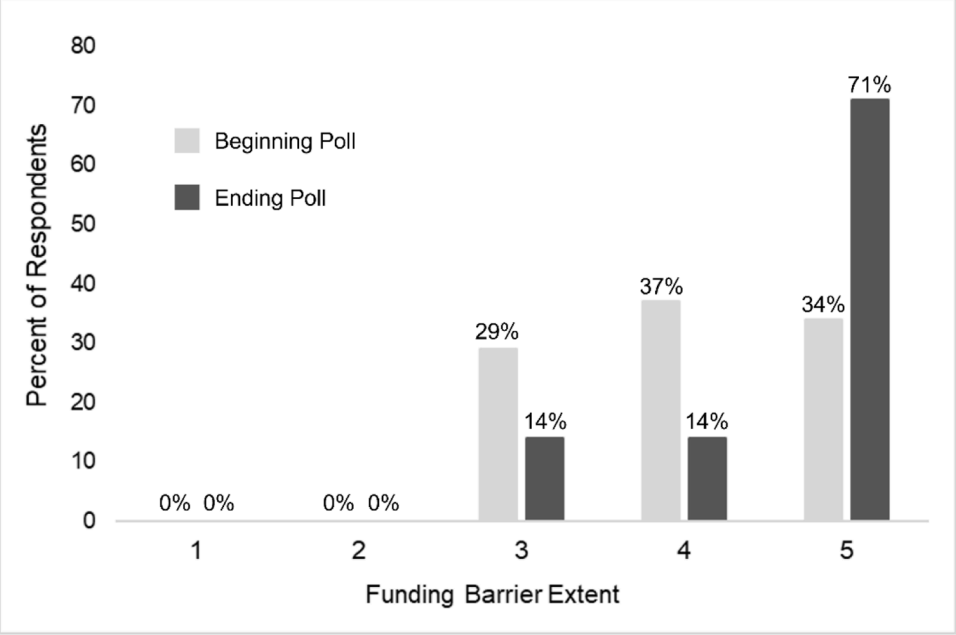

Fig. 1. Poll results of workshop participants posed the question, "In your opinion, how much of a barrier is animal methods bias in funding to the broader acceptance and use of nonanimal research approaches?" at both the start ($n = 35$) and end ($n = 14$) of the workshop. A ranking of ``1'' represented no barrier and a ranking of ``5'' represented a high barrier.

Table 2.

In the second session of the workshop, stakeholders discussed the pivotal role that funding organizations must play in addressing animal methods bias. Insights were shared regarding how funders can drive the adoption of NAMs and other nonanimal methodologies and tackle biases within the research evaluation process. It was highlighted that certain funding bodies, such as the NIH and the EC, have implemented comprehensive programs to promote nonanimal research (e.g., the NIH Complement-ARIE Program (NIH Common Fund, 2024) and the EC call on Innovative non-animal human-based tools and strategies for biomedical research (European Commission 2023)). These programs involve substantial funding, fostering societal impact and identifying areas where new knowledge is needed, including the value and validation of nonanimal methods.

Table 2
Recommendations for researchers and funders to help mitigate animal methods bias in funding assessments.

Domain	Researchers	Funders
Awareness and training	Raise awareness of animal methods bias among your institution and scientific community. Educate and train the scientific community in nonanimal research methods and their value in translational success, especially early-career researchers.	Raise awareness of animal methods bias and the value of NAMs among reviewers and review staff. Implement required bias mitigation training that includes information on scholarly biases, including how to recognize and address biases in the evaluation of research methods.
Funding opportunities	Seek funding from appropriate sources. Ensure funding opportunities have appropriate method specifications and reviewer expertise.	Invest in NAMs-specific funding streams. Do not exclude NAMs from funding opportunities or seek animal-only proposals.
Method suitability	In proposals, provide a robust justification for the use and suitability of the chosen methods to answer your specific research question and impact human health.	Implement evaluation criteria that assess methods based on their suitability for the research question, context of use, translatability, and human relevance, ensuring impartiality toward animal- and nonanimal-based approaches.
Review group processes	Identify and address biased comments of fellow reviewers.	Implement bias reporting mechanisms. Employ rough-rating evaluation scales and open decision-making processes (Langfeldt, 2022). Allow rebuttals to reviewer decisions.
Review group composition	Volunteer for reviewer positions and make yourself available to review staff.	Ensure that review groups include members that have experience using NAMs and can adequately evaluate their suitability for the specific research question or context of use. Open review groups to early career researchers, especially those who have experience in innovative, human-relevant technologies.
Open science	Engage in open science practices such as systematic reviews, data sharing, and preregistration of studies.	Encourage and incentivize open science practices such as systematic reviews, data sharing, and preregistration of studies.
Policy and infrastructure	Advocate for policies and initiatives that support the development and use of NAMs and the mitigation of animal methods bias.	Invest in research infrastructures, such as new centers for animal-free biomedical research, to facilitate the transition towards nonanimal approaches. Facilitate the investigation of animal methods bias evidence in review reports and funding rates.

Several actionable recommendations that emerged from the workshop to be considered by researchers and funders are summarized in Table 2. Briefly, efforts to mitigate the risk of animal methods bias include raising awareness among reviewers, formulating guidelines, ensuring the inclusion of NAMs experts in review processes, increasing multidisciplinarity among evaluators, implementing criteria for assessing the translatability of research models, and adopting double-blind review processes to reduce biases. These steps aim to ensure that research methods are chosen based on their translational potential and suitability for the research questions, rather than defaulting to traditional animal models. In the time since the workshop, NIH CSR unveiled a new framework for evaluating reviewers, which contained an indicator that aims to evaluate reviewers on methodological bias—the first acknowledgement of such a bias, to our knowledge, and an important step in mitigating animal methods bias. By adopting these recommendations, funding organizations can play a pivotal role in reducing animal methods bias and promoting the use of innovative, nonanimal research methodologies.

A key theme that emerged from the workshop was the variety of animal methods bias experiences among researchers, likely influenced by multiple factors with complex interactions at various levels. Differing experiences may be partially explained by regional differences in animal use regulations and government investments in initiatives to advance nonanimal approaches. Likewise, they may be partially explained by the composition of expertise on review groups; concentrations of expertise in animal-based methods may bias review groups toward the funding of projects employing animal-based methods and the rejection of projects employing nonanimal-based methods. Finally, grant application content may also contribute to these differences. Stakeholders emphasized the need to provide a robust rationale for nonanimal approaches proposed, ideally situating them in a systematic review of methodologies for a given research question, including advantages and disadvantages. They also emphasized that without structural support for research employing nonanimal approaches—through funder investment priorities, review criteria, proper reviewer expertise, and other policy changes—individual efforts to make grant proposals more competitive can only go so far.

The stakeholder workshop approach employed has limited ability to draw generalized conclusions about the nature and impacts of animal methods bias in funding assessments. It does, however, offer insights into future avenues for investigation. Further research and analysis are needed to fully characterize animal methods bias in funding, including how it manifests in reviewer comments and reports, its prevalence, whether it occurs more frequently in certain research areas or global regions than in others, and its impacts on researchers and funding rates. This evidence can be partially gathered through self-reported measures, such as qualitative interviews or surveys, but the most objective means may be through systematic assessments of review reports. Funding agencies keep review reports private for good reasons—to protect researcher intellectual property and review group deliberative decision-making. They do occasionally provide independent meta-researchers with access to reports and they use them for internal investigations. Funders must thus play a crucial role in gathering evidence of animal methods bias, either by providing meta-researchers access to review reports or conducting their own investigations. Generating buy-in among funders is a necessary first step. Systematic data and evidence from self-reported measures can help generate this buy-in, as can stakeholder advocacy, particularly from NAMs developers and users. Evidence gleaned from these efforts will be crucial for understanding animal methods bias and its impacts on research assessments and for developing effective strategies to address it.

This workshop built on our foundational understanding of animal methods bias by integrating survey evidence on its occurrence in publishing (Krebs et al., 2023b) with preliminary data and anecdotal accounts of possible animal methods bias in funding. As a result, a preliminary understanding of this specific methodological bias in funding decisions was developed. Personal stakeholder perspectives offered insight into the possible causes of animal methods bias in funding assessments, as well as actionable steps that researchers and funders could take to avoid its potential impacts. Governments and private funders around the world are increasingly interested in advancing nonanimal research approaches to improve clinical translation and to reduce animal use. While animal methods bias may pose a significant barrier to these efforts, it remains a newly identified phenomenon. Increasing awareness of it among biomedical research stakeholders will be crucial for developing a comprehensive understanding of its dimensions and effectively addressing its impact. Future efforts will be needed to grow this understanding, especially through further evidence gathering, and to explore how best to mitigate its harmful effects. The COLAAB aims to continue raising awareness of animal methods bias through events like this workshop and other venues, such as webinars and conference presentations. It is also beginning to systematically explore potential regional differences in the determinants and impacts of animal methods bias in a variety of research assessment scenarios. Finally, the COLAAB will continue advocating for research policy and practice changes to ensure that review-related biases do not hinder the broader use of nonanimal biomedical research approaches. We encourage other research stakeholders to take this challenge on as well, especially by exploring and implementing the recommendations described herein.

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CRediT authorship contribution statement

Catharine E. Krebs: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. **Sven Geissler:** Investigation, Writing – review & editing. **Kathrin Herrmann:** Conceptualization, Investigation, Resources, Writing – review & editing. **Kenneth Kandaras:** Investigation, Writing – review & editing. **Owen Kavanagh:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Laura M. Langan:** Investigation, Writing – review & editing. **Francesca Pistollato:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Sandeep Raha:** Investigation, Writing – review & editing. **Ignacio J. Tripodi:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft. **Emily R. Trunnell:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no conflict of interest.

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Supplementary materials

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Data availability

All data are incorporated into the article and its online supplementary material.

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