INNOVATING IN THE RESEARCH FUNDING PROCESS: PEER REVIEW ALTERNATIVES AND ADAPTATIONS

Horizon Scan

By Susan Guthrie, RAND Europe

NOVEMBER 2019

Prepared for AcademyHealth

Paradigm Project

AcademyHealth

ABOUT THIS HORIZON SCAN

Peer review is the dominant mechanism through which most research is funded internationally. However, as demand for funding outstrips available resources, peer review is struggling to deliver, with evidence of bias, burden, conservatism, and unreliability starting to emerge. Some fields, including health services research (HSR), are also grappling with how to make funded research more relevant to policy and practice. It is time to turn the scientific method on the research system and start to explore what options might be available to innovate in our funding processes. Commissioned by the AcademyHealth Paradigm Project, this paper sets out some options for modifying or replacing peer review in the research funding system: lotteries; self-review; open peer review; broadening participation; innovation prizes; and new technologies. Each has their advantages and disadvantages, and all need to be explored and evaluated more fully within the context of the scientific system. But with pressures on funding impacting on all aspects of the scientific system, from research integrity to researcher wellbeing, the time to act is now.

ABOUT THE PARADIGM PROJECT

The Paradigm Project is a concerted, collaborative effort to increase the relevance, timeliness, quality, and impact of health services research (HSR). Convened by AcademyHealth and funded by the Robert Wood Johnson Foundation, the project is ideating and testing new ways to ensure HSR realizes its full potential to improve health and the delivery of health care. The Paradigm Project is designed to push HSR out of its comfort zone—to ask what works now, what doesn't, and what might work in the future.

Learn more at www.academyhealth.org/ParadigmProject.

1. INTRODUCTION AND CONTEXT

The way in which research funding is allocated is a critical part of the scientific system. It determines what research is conducted, by whom, and in which locations. Getting those decisions right can have a significant impact on the progress of science, and in the case of health research, the development of new interventions that can save lives. For the vast majority of public and charitably funded research, those decisions are made using peer review. Peer review is a process in which 'peers' – typically other researchers in the same field of research – review funding applications and their views on the quality of the applications, which may be defined in different ways depending on the nature of the funding program, are used to inform the decision on where funding is allocated. Peer review is well regarded by most in the academic community:[1] it is based on expert judgement, and allows the academic community to be the key decision-makers regarding how funding is allocated. However, despite this widespread use – with peer review systems varying very little between funders – the effectiveness, and efficiency, of peer review for funding allocation is largely untested. Despite being widely used by the scientific community, very few efforts have been made to turn the scientific method on peer review itself. This lack of critical examination is particularly striking given the extent to which rigor, objectivity and rationality are valued in the conduct of science itself.[2]

Despite being widely used by the scientific community, very few efforts have been made to turn the scientific method on peer review itself.

Indeed, the evidence suggests there may be significant problems in the current way that research funding decisions are made. We have researchers spending a third of their time writing grant applications rather than doing research.[3] Peer reviewers are spending hours reviewing lengthy applications to produce decisions that are in many cases little better than chance.[4] And with insecurity around funding, researchers are under increasing pressure to produce meaningful results and publish in the best journals – which can lead to questionable behaviors contributing to the crisis we see in research integrity. As much as half of research published may not be reproducible,[5] and an estimated 85 percent of research funding in medical research is wasted on studies which are biased, unpublished, poorly designed or inadequately reported.[6] In summary, the evidence we have on peer review points to a number of specific limitations[7] notably:

- Decisions may be subject to **conservatism** and a reduced chance of selecting risky, innovative proposals;[8]
- Poor power to **predict** research outcomes;[9]
- **Inconsistency**, with assessments varying across reviewers;[10]
- Possible **bias** on the basis of gender,[11] age[12] or cognitive approach,[13] and a risk of cronyism;[14]
- **Burdensome** and time-consuming (particularly for applicants, but also for reviewers).[15]

LIMITATIONS OF PEER REVIEW

- Decisions may be subject to conservatism.
- Poor power to predict research outcomes.
- Inconsistency, with variation across reviewers.
- Possible bias on the basis of gender, age or cognitive approach, and a risk of cronyism.
- Burdensome and time-consuming.

Both researchers and research funders acknowledge the limitations of peer review, yet its use remains widespread and widely accepted.[16] One of the main challenges in assessing the performance of peer review is the relative lack of comparators.[17] Since the vast majority of funding is allocated through very similar mechanisms across research funders globally, it is hard to make a comparative assessment of peer review's performance relative to other potential approaches. Another challenge is access to data, with funders sometimes unwilling to share detailed information on their peer review processes and their outcomes to allow for analysis and assessment. There needs to be more experimentation and openness regarding peer review – reflecting the inherent limitations and indeed the unacknowledged element of chance already present within the current system.[18]

One important factor driving many of these issues is the availability of resources. Internationally we see evidence that success rates are falling – that is, a lower proportion of funding applications are successful. This places additional pressure on the peer review system – which, though effective in discerning between 'fundable' and 'unfundable' applications, is much less effective in discriminating between the 'good' and the 'very good'.[19] Often the difference in quality between funded applications and those coming close but missing out is very minimal – but the implications for the direction of science and careers of those involved can be considerable.[20] Peer review is not necessarily well placed to address these challenges as demand outstrips funding resources.

In this context, we set out a number of examples of ways in which peer review can be adapted or replaced to develop new and novel systems for funding research. Such innovations could serve as inspiration for funders and drive more openness, experimentation, and variety in research funding.

2. ALTERNATIVES AND ADAPTATIONS TO PEER REVIEW: CASE STUDIES

This chapter describes a number of innovative ways in which funders could alter their research allocation processes, using alternatives to peer review, or modifying and adapting within the scope of a peer review process. Each example sets out the rationale behind the approach, the potential advantages and challenges, and the evidence available for its effectiveness. The approaches covered in the chapter are:

- **Lotteries:** Random allocation of funding by lottery – either across all awards, or following initial triage to remove those which are not of sufficient quality for funding
- **Self-review:** Review of applications by the applicant pool
- **Open peer review:** More transparency in the peer review process – from sharing of reviewer identities to open publication of funding applications and accompanying review
- **Broadening participation/crowdsourcing:** Involvement of different groups in the peer review process – from wider disciplines, through research users (e.g. patients, clinicians) to the general public, including 'crowdsourcing' approaches
- **Innovation prizes:** Rather than awarding funding for research, offer prizes for answering a particular challenge or problem
- **Using new technology to enhance the funding review process:** Using technology to support and improve the grant funding process, by facilitating peer review panel meetings, helping identify peer reviewers, and supporting the review of the quality and novelty of research.

This is by no means an exhaustive list of potential avenues for modifying the peer review process. For example, some suggest funding people rather than projects,[21] which is already a well-established approach at some major funders including the Wellcome Trust and the Howard Hughes Medical Institute. However, it is intended to provide some useful examples to promote reflection and discussion.

2.1. Lottery

Evidence suggests that getting research funded through peer review is to some extent a process of random chance with very different outcomes depending on the makeup of the reviewing panel.[22] Given this, a suggestion increasingly gaining traction is to acknowledge and build on this randomness and award research funding by lottery. A number of different possible models for research funding by lottery have been proposed. Most approaches are based on the principle that a light touch peer review process is needed to divide applications into 'fundable' and 'unfundable' – the level at which peer review is most effective in its discernment. Next steps are then variable. Some suggest completely random suggestion within the 'fundable' bracket. Others suggest determining the 'threshold' for inclusion based on the payline (i.e. the level above which research is funded).[23] For example, if the payline is 10 percent (i.e. the top 10 percent of applications are funded), the peer review process might select the top 20 to 30 percent of applications for inclusion in the lottery process – a much less labor intensive process which may not require a panel meeting, for example. Another option would be to use a lottery approach for those proposals where the evaluation of merit is difficult or inconclusive – so the peer review process is not just to eliminate the unfundable applications, but also the outstanding proposals which should be funded automatically outside of the lottery process.[24]

Lotteries confer a number of advantages beyond standard peer review-based funding processes. Firstly, they reduce the level of bias. Since decision-making is random, no group is favored or disadvantaged. Although there may still be biases in qualification to the 'fundable' group, at least the process for selection within that bracket, being completely random, is without bias. In theory, they should also reduce burden. Since applicants only need to demonstrate that their applications meet the quality threshold for funding, rather than trying to distinguish themselves within a highly competitive landscape, less effort may be needed to 'gold plate' every word in the funding application. In addition, if eligible applications that meet the threshold but are not selected are entered into the next funding round automatically, that would eliminate the need to revise and resubmit already adequate proposals.[25] Similarly, peer review processes become more straightforward and hence potentially less time consuming, since the level of discernment required is much lower. Finally, the approach would acknowledge the inherent limitations of the peer review process in distinguishing between good and very good proposals and reorient its use to those elements of the decision-making process where it is most effective.

LOTTERY PROS & CONS

Pros

- Reduces bias
- Acknowledges inherent uncertainty in peer review
- Reduces burden on funders, reviewers, and applicants

Cons

- Potentially politically unpalatable
- Need to select between a few different practical options for implementation
- As yet largely untested

Challenges in the use of lotteries may be around acceptability and attitudes towards acknowledging – and even openly embracing – the randomness in funding decisions. This could potentially be demotivating for some in the academic community and is potentially a risky message for funders to convey.[26] Removing the process of review also could remove the opportunity for refinement and improvement of proposals through the input of peers.

Use of lotteries in funding allocation is so far fairly limited. One notable example is the Explorer Grants program funded by the Health Research Council of New Zealand since 2013, which offers awards of NZ$150,000 for 'transformative research ideas that have a good chance of making a revolutionary change to how we manage New Zealanders' health'.[27] Applications are assessed by relevant subpanels to ensure they meet the criteria of being both transformative and viable, and amongst those applications that meet the criteria selection is made using a random number generator.[28]

This limited use means that very little evidence is available on the effectiveness of a lottery approach for funding. However, modelling approaches suggest that the approach could offer advantages in delivering a more diverse and inventive portfolio.[29] Also, given the limitations of peer review mean that up to one-third of grants may already being awarded at random,[30] the approach is perhaps not as radical as it seems.[31]

2.2. Self-review

One challenge in peer review processes is seeking timely, high quality reviews of applications from knowledgeable individuals. The process of identifying, collating, and moderating (typically through an in-person meeting) a group of peer reviewers is both burdensome, and extends the time between application submission and decision significantly. One radical approach to address this is to assign reviewers from within the applicant pool, with timely delivery of reviews of other proposals mandatory for your own application to be considered.

Typically, all applicants involved in a particular call are conflicted out of the reviewer pool – and in small fields of research or smaller countries this can lead to significant issues in identifying a sufficient number of qualified reviewers. Furthermore, peer reviewers have limited incentive, beyond scientific citizenship, to participate as reviewers, which can be a time consuming exercise, and funders have little leverage to drive timely and high quality delivery of reviews. Selecting reviewers within the applicant pool gives reviewers buy in and funders leverage to drive the review process.

The idea was proposed by Merrifield et al. (2009) as a way to improve the process for allocating time on telescopes in astronomy research. They pointed to the advantages not just of timely delivery of results, but also drawing on community consensus regarding the most exciting and innovative science. The concept was taken up in a wider setting by National Science Foundation (NSF) in 2013, in which 131 applicants to one of their funding streams were required to assess seven competing proposals as a condition of submitting their own application. Applicants were asked to both review the quality of the seven proposals then rank them. This used a novel scoring process intended to dissuade applicants from purposefully downgrading good applications for their own advantage. Specifically, applicants receive bonus points for their own applications where their assessments aligned with those of others.

SELF-REVIEW PROS & CONS

Pros

- Reduces burden on funders in identifying reviewers
- Incentives timely review delivery
- Draws on wisdom of the crowds

Cons

- Mechanism needed to ensure there is no gaming of the system

Though not formally evaluated, and only used experimentally for one funding round, many of the outcomes identified were positive.[32] Each proposal received seven reviews, rather than the usual three or four – providing a more diverse range of perspectives and eliminating the need for a panel review session. This lack of a face-to-face meeting combined with reduced burden in identifying reviewers saved the NSF time and money. There were also suggestions that the quality of reviews improved, though this is based on the use of review length (which was longer on average by 40%) as a proxy for quality. One concern is that the 'bonus points' system for consensus might promote conservatism and 'playing it safe'. Also not further explored is the challenge that the approach primarily focuses on reducing the burden for the funding organization. While this may be valuable, evidence suggests that around 80-85 percent of the burden in funding application processes lies with the applicants[33] – adding seven peer reviews to their requirements is unlikely to improve this.

2.3. Open peer review

Open peer review is growing in popularity in the review of journal articles but has yet to be employed in the context of funding review. In open peer review, both the names of reviewers and submitting researchers are known to each other, and indeed the reviews can be made publicly available for others to see. Open peer review is conceptually intended to serve multiple purposes. Reviews being made openly available could drive transparency or impact upon the behavior of reviewers – perhaps helping make them more constructive than critical,[34] and potentially helping to address risk of bias. Open review could also help compensate reviewers for the time spent on review, by openly acknowledging their contributions.

OPEN PEER REVIEW PROS & CONS

Pros

- Improve review quality and fairness
- Increased transparency
- Scope for learning and sharing of ideas
- Credit provided to reviewers for their efforts

Cons

- May concern applicants in terms of protecting their intellectual property
- Risk that reviewers are unwilling to be critical
- Requires careful consideration of unintended consequences
- Limited application in funding context

Open peer review can be characterized at a number of levels,[35] of which three are perhaps most pertinent to a funding application review context: open identities, open review, and open interaction.[36]

At the simplest level, identities are shared – with both the reviewer and applicant aware of each other's identity. This is posited to offer advantages in improving transparency and accountability; enabling credit to be assigned to reviewers; preventing reviewers 'hiding behind' anonymity when criticizing the work of others;[37] and making any potential conflicts of interest more evident and open to scrutiny.[38] Others suggest reviewers may shy away from being critical in this context,[39] and there is a risk that bias is increased when identity of applicants is known – though in reality, most application processes are only blinded to the applicant, not the reviewer. Most evidence about the impact of open identities on the content and tone of peer review (in a journal review context) shows very little effect,[40] though one survey of journal reviewers suggests that open identity reviews may be higher quality, more courteous, and more likely to recommend publication, though also more time consuming.[41]

The next potential interpretation of open peer review is 'open reports', in which both application and review reports are made publicly available alongside one another. The potential benefits of this approach include increased transparency and accountability, and the opportunity to make currently hidden, but potentially useful scientific debate openly available to inform the scientific community.[42] It also opens reviews to scrutiny, which can incentivize reviewers to ensure their reviews are thorough and defensible.[43] Finally, it can also provide an opportunity to acknowledge the contribution of peer reviewers, recognizing their efforts.

This has been operationalized in the context of journal peer review through online platforms such as Publons which record, verify, and showcase peer review contributions – though until these are acknowledged and incentivized more widely, this is unlikely to make a substantial impact in promoting timely and high quality reviews.[44] There are also other theoretical approaches building on distributed ledger technology, such as blockchain, which could be used to create a record of peer review contributions and could potentially be linked to subsequent benefits – traded for journal publication costs or conference fees.[45] In the context of application peer review, it could be that 'points' for peer reviews conducted could be traded for peer reviews of one's own applications, though careful consideration would be required regarding oversight of such a process.[46]

The evidence on the impact of open reporting on reviewer participation and review quality is limited and based on journal review, with one study finding no effect on review quality, though a higher refusal rate amongst individuals asked to provide a review,[47] and another survey funding generally positive attitudes to open reporting in a journal review context.[48]

Finally, a further open peer review approach is 'open interaction' in which reciprocal discussion between the applicant(s) and reviewer(s) is enabled and encouraged. This is in contrast to usual peer review processes in which dialogue between reviewer and applicants is restricted to at most one response or 'rebuttal' from the applicant, mediated through the funder. This could offer benefits in terms of shared discussion and interaction, improving communication and looking for ways to improve an application collectively.[49] The process could also be beneficial for applicants – even when ultimately unsuccessful – by refining their ideas and improving their understanding of the decision-making process, so they are better able to develop and target their ideas in future. One way in which this has been effectively implemented in a funding context is through 'sandpits'.[50] There are events in which applicants, funders and reviewers come together for a workshop in which they work together to discuss and revise proposals collaboratively. This can promote transparency, make researchers feel more engaged in the decision-making process, and improve the proposed research. Typically decisions regarding funding are made at the end of the workshop – giving a finite timeline for the decision-making process, and avoiding a lengthy process of proposal review and revision. However, such events are reliant on appropriate selection of participants and effective facilitation.[51] There is also a risk that dominant individuals can skew the process, if the facilitation is not effective, and that biases – particularly in terms of hierarchy – might play out in the discussion process.

2.4. Broadening participation and crowdsourcing

Peer review has typically been limited to a small, funder-selected group of subject matter experts. However, restricting the process to these individuals can contribute to risks of bias,[52] and also creates challenges in identifying and seeking reviews from what is often a fairly limited group of established experts. Opening up peer review may increase number of reviewers, which can improve the reliability of peer review.[53] It may also be that disciplinary experts are less open to new and novel approaches and perspectives, limiting innovation, with wider groups offering increased breadth of thought.[54] Broadening participation in peer review could address some of these challenges.

BROADENING PARTICIPATION PROS & CONS

Pros

- Increased transparency
- Potential for increased openness to innovation and less cognitive bias
- Where participants are patients, potential to learn from experiences and build trust and buy-in

Cons

- Lay reviewers have less technical expertise
- Reviewers may not respond or provide limited input
- Risk of unequal participation between lay reviewers and academics

In the health research context this is especially pertinent. Many peer review processes[55] already incorporate perspectives from patients and members of the public – from the priority setting phase through to involvement in peer review panels.[56] Evidence suggests that including these wider perspectives in peer review processes can result in increased awareness of real-world challenges faced by individuals amongst the scientific community, more acceptance and uptake of research findings by patients and the public, and more effective use of research resources.[57] Panel members themselves – both lay and academic participants – have been found to be positive about the process and the contribution that lay panel members can make – with a particular increase in positive viewpoints amongst researchers after experience on a mixed panel.[58] One of the major challenges in such approaches is that there is a risk that academics still dominate the discussion in mixed panels – with one approach suggested to address this being selecting non-academics to chair peer review panels.[59] Another challenge is that not all researchers – many not having experienced a sitting on a mixed panel – value lay contributions in peer review,[60] and express concern about the ability of lay peer reviews to assess complex science adequately.[61]

Going further than this – and combining a wider participation and redefinition of the concept of 'peer' with open peer review approaches described above – peer review could be extended to a crowdsourcing approach. In a crowdsourcing paradigm, anyone would be able to openly comment on and review applications.[62] This has the potential to improve the quality of research,[63] and to draw more effectively on the democratic wisdom of the crowd.[64] Examples of how this is employed include 'experiment.com',[65] in which different researchers seek funding from members of the public for their ideas – with information provided about the progress of the work in the form of 'lab notes'. In the context of charitably funded research, some element of broad engagement in the selection of projects and corresponding commitment of donations could be feasible, and even where the funding doesn't come directly from members of the public, there could be scope for people to rate or rank possible topics.

This approach has potential challenges and limitations, however. Firstly, the approach relies on the extent to which ideas can readily be communicated to non-experts. Certainly researchers should be expected to find ways to communicate the content and value of their work to non-academic audiences; however it remains true that some ideas are more readily communicated than others, regardless of their scientific value. Members of the public are also less qualified to make assessments about the novelty of ideas (relative to prior and ongoing work) and their feasibility.[66] Researchers might also be uncomfortable in sharing their ideas with others at the proposal stage – there is the risk that others might use or build on their ideas. However, if their ideas are in the public domain, this could potentially be considered as a type of 'pre-print', indicating their role in the development of a concept – and documents could potentially be cited where used in further work, recognizing these contributions. Finally, there may be challenges in ensuring sufficient levels of participation from self-selecting reviewers, if the review process is completely open, with the possibility that few individual respond, or that the scope and completeness of reviews is limited.[67]

2.5. Innovation prizes

Innovation prizes are typically used to address important challenges or problems in the real world. They set out a problem or issues to be addressed, with clear criteria for success, and offer a (usually significant) financial reward for the first team or individual to successful address the challenge set. This approach is different from standard funding models in a number of ways. Firstly, funding is received after the work is completed, rather than before. Secondly, only the winning team receives the funding – there is no reward for effort alone and many parallel teams may be working on the challenge with only one ultimately receiving the money. Finally, these competitions tend to be completely open – the nature and composition of the team, the specifics of the solution, and the details of how the solution is reached are not specified. Only the required outcome is specified with the rest left to the discretion of the competing teams.

The idea of innovation prizes is not new. One of the most frequently cited[68] historical examples is the longitude prize, a challenge issued in 1714 offering a prize of £20,000 (equivalent to around £2.5 million today) for a mechanism for the precise determination of longitude. The prize was set by the British government in response to a prominent navigation disaster and the prize ultimately awarded in the 1770s.[69]

There are many more recent examples in a range of contexts – from the DARPA Grand Challenge to produce an autonomous robotic vehicle for use on the battlefield, to the Methuselah Foundation M-Prize for longevity. The idea has grown in popularity, to the extent that in 2010 the America COMPETES Reauthorization Act was passed, authorizing the use of prizes across a range of contexts by US Federal agencies.[70]

The aim of such prizes it to inspire creative solutions to address significant and sometimes seemingly intractable problems. The approach can help draw on a more diverse range of stakeholders than typical funding mechanisms[71] and enables unexpected ideas to be explored drawing on different disciplines and conceptual underpinnings. The process itself therefore has the potential to produce numerous innovative outcomes.[72] For a funder, since the money is only awarded after desired outcomes are achieved, financial risk is significantly reduced – and instead passed on to those competing for the award, which can also generate greater investment overall in an area than the value of the fund.

One of the key challenges in innovation prizes is ensuring clarity and impartiality in the assessment of success. Problems can arise where the winner is not clear cut, or the judging process is poorly defined or subjective. The Longitude prize mentioned above is an example of this, with the prize only awarded after a lengthy appeals process. Another issue is equality of opportunity. Since funding is not available up-front, this might limit access and participation, so this would not be appropriate as a sole funding mechanism, but may be effective within a system where other ex-ante funding mechanisms are also available to provide resources at the outset to enable a wide range of participants to engage.[73]

Some prize awards have clear-cut winners, but others do not. The judging process must be well defined, minimize subjectivity, and allow for appeals in order to ensure the credibility of the prize decision – otherwise there is a risk of favoritism and industrial influence. Equality of opportunity may not be achieved for participants with insufficient cash flow to initiate projects without ex-ante funding.

INNOVATION PRIZES PROS & CONS

Pros

- Promotes innovative ideas and open to broader range of participants
- De-risks investment for funder
- Enables large scale challenges to be addressed

Cons

- Requires a clearly specified problem
- Assessment must be clearly delineated and free from bias
- Does not offer up-front resources which could exclude some from participating

Empirical assessment of the effectiveness of innovation prizes is limited. A review by Murray et al (2012) identified a number of interesting observations – particularly regarding motivations of those participating in prize competitions. The potential financial rewards from 'winning' the competition are often only one of a number incentives for engagements – including publicity, attention, credibility, access to funds and testing facilities, and community building. Similarly, they highlight that the motivations for prize-givers may also be multiple – not just to promote innovative effort but also to draw attention to an issue, improve awareness and education, raise credibility, and demonstrate the viability of different avenues of R&I. As such, even if a 'winner' is not found, the prize may be a success – and, indeed, vice versa.[74] Kay (2011) highlights that this range of diffuse motivations, particularly those that are non-monetary, may be one of the reasons that prizes are able to attract unconventional entrants – and this in turn is a key factor in producing novel innovative outcomes.[75]

One way in which the prize concept has been mobilized in a medical research context is through Advance Market Commitments (AMC). This is where sponsors commit in advance to a guaranteed price for a set number of units of a new medical innovation, before such a product is developed and licensed.[76] An example where this has been put into practice is in vaccines for neglected diseases, with an AMC for pneumococcus vaccine suitable for children in the developing world launched in 2009 with a commitment of US$1.5 billion from the Governments of Canada, Italy, Norway, the Russian Federation, the United Kingdom of Great Britain and Northern Ireland, and the Bill & Melinda Gates Foundation. In a 2015 evaluation, it was found that the AMC pilot was effective in accelerating immunization coverage against pneumococcal disease across 53 countries.[77]

2.6. Using new technology to enhance the funding review process

New technologies offer the potential to improve the grant funding process. Examples of the ways in which technology can enhance the process include the following:

- Facilitating peer review panel meetings
- Helping identify peer reviewers
- Supporting the review of the quality and novelty of research

Some of the ways that technology can support each of these are set out below.

USING NEW TECHNOLOGY PROS & CONS

Pros

- Reduces burden on funders in organizing
- Reduces burden of delivering peer reviews
- Quality of assessment of novelty and scientific merit

Cons

- Doesn't address applicant burden
- Some technologies not currently adapted for application review
- Could reinforce existing biases

2.6.1. Facilitating panel meetings

One of the major burdens on funders in peer review processes is organizing and paying for groups of reviewers to come together for panel meetings. Challenges in scheduling can also mean that these events take place infrequently, slowing down the decision-making process. To address this, two funders have experimented with the use of virtual panel meetings. One used a relatively low-tech approach, comparing face-to-face meetings with teleconferencing, finding that the differences in scoring distributions between the two approaches were minimal.[78] This reflects an experimental study mirroring NIH review procedures, which found little difference in scores between face-to-face and videoconference meetings.[79] Taking a more novel approach, NSF experimented with the use of Second Life, a virtual world, to host peer review panels in 2009. Participants found the panel process similar, though some missed the social aspects of meeting in person[80]

– something also observed in the use of videoconferencing.[81] However, cost implications could be significant - NIH estimate that using second life in place of in-person meetings for panel discussions could cut panel costs by one third.[82]

2.6.2. Identifying and assigning reviewers

Another significant burden on research funders is the process of identifying and assigning reviewers to each application. Typically this is done manually by staff within the funding organization – who may have differing levels of expertise in the subject area – and can take considerable time – particularly since multiple reviewers need to be identified as those selected may decline to participate. Artificial intelligence (AI) and machine learning offers the potential to automate, or at least reduce the burden of this process. This has been implemented, in the context of publication review, by the tool 'SubSift', which has been used to identify reviewers for papers submitted to a data mining conference – with reviewers highly satisfied with the process[83] – as well as in several other major conferences. The approach is based on a full text analysis of publications in bibliographic databases to match content and expertise of reviewers to publications.[84] Text mining approaches have also been explored by others, developing approaches which can match reviewers to publications through analysis of their published works and comparison of the content to the focus and content of papers to be reviewed.[85] There is certainly potential to apply comparable approaches to proposal review. An early attempt to do this was made by CIHR (Canadian Institutes of Health Research), implementing an AI-based system for selecting reviewers. The approach met with mixed success and was unpopular with the scientific community, but in a subsequent review by an international expert panel, it was considered that challenges in implementation and the wider context may have contributed to this poor reception, and that technology could have scope to contribute effectively to reviewer identification and allocation.[86]

2.6.3. Reviewing the novelty and quality of work

Technology can also play a role in the review of the novelty and quality of work.[87] Turnitin,[88] software to detect plagiarism, is already well known in the context of undergraduate student work, and could also be used for the analysis of academic papers. Similar approaches could be used to assess the novelty of proposals compared to other submissions and/or previously published work – expanding significantly on the usual reliance on the breadth of knowledge of a small number of reviewers to assess the novelty of work. This type of automation can also assess whether a research applications meet the basic requirements for submission, to validate the author's identity and institutional associations, and to assess the scientific accuracy of the content. Tools such as StatReviewer[89] are also available to assess the statistics used in publications to ensure that information such as sample sizes are correctly included. This again has scope to be applied to assess the methodological design of research proposals. UNSILO[90] software uses natural language processing and machine learning to analyze manuscripts, identify key concepts and summarize content (Heaven 2018), which could help facilitate peer review – particularly in helping with a more light touch review, or enabling review by wider audiences.

Use of these new technologies does not constitute a radical reformulation of the peer review process in their own right – and as such, they have limited scope to address some of the key challenges with peer review in isolation. However, they have the potential to support the existing system, and also can facilitate new and novel approaches. For example, if a wider range of reviewers is included in the peer review processes – including non-experts – having automated approaches to check for some technical details such as appropriate use of statistics, and to eliminate the risk of plagiarism (since reviewers may be less familiar with the prior work in the field) could be particularly helpful.

3. DISCUSSION

Peer review is no longer working as effectively as the research system needs.[91] As more scientists chase a smaller pool of resources the system is starting to face challenges. There is a clear rationale for change, but with peer review so dominant and entrenched, it is difficult for funders to see ways to make those changes. This report has set out some clear options, summarized in Table 1, with examples of use in practice, that could be adapted or combined for use across disciplines. No one option is the perfect solution, but together they present some routes through which funders could experiment with new funding approaches to try and address the key challenges facing the research funding system.

No one option is the perfect solution, but together they present some routes through which funders could experiment with new funding approaches to try and address the key challenges facing the research funding system.

In the context of health services research, of particular interest is the potential to include a wider range of participants in the peer review process. Engaging more patients and clinicians in the process of research funding could help promote transparency and build confidence in the system, as well as driving more patient-oriented and applicable research.[92] This is already starting to happen but increased openness and engagement, as set out in 'open peer review' and 'broadening participation' offer scope to strengthen and build on the status quo. Other options are widely applicable but could be tailored to the health services context – with prizes for example used to help bring a wider range of actors into the research process in innovative ways, or new technologies used to support reviews (checking elements such as statistical design, for example), to better enable individuals with a wider range of backgrounds to contribute reviews. Equally, health services research faces similar challenges to other research areas, such as burden of application processes and the potential for biases, conservatism and lack of reliability in decision-making processes. All of the options presented offer scope for application in the health services research setting and could deliver benefits across different elements of these universal challenges. Health services research has one advantage over many other fields of research in that its funders include charitable and private foundations. These organizations may have more scope to make changes to their processes and fund in new and novel ways than government funding bodies. This opens up the possibility for more experimentation and to test out ideas that could potentially spill over into other funders if their effectiveness is demonstrated and acceptability to the sector built.

Some of the options presented are more incremental and others more radical. This presents funders with options to make change depending which issues they wish to address, and how radical they are prepared to be. Some may feel that these changes are too risky in the context of potential pushback from the academic community. However, the risks of change need to be weighed against the consequences of inaction. Already public support for biomedical research is declining relative to other priorities.[93] If we can't demonstrate that research funding is being spent and allocated in a sustainable and fair way, this could have serious long term implications for the research system. The costs to researchers themselves are also high. Increased pressure and competition for funding is implicated in increased levels of stress and impacts on family and personal life among academics.[94] We need to act to improve our research funding systems, acknowledge the challenges and problems, and work collectively to address them.

Table 1 Summary of approaches

Approach	Summary	Advantages	Challenges
Lottery	All or part of the funding allocation process is completely random, based on a lottery	Reduces bias Acknowledges inherent uncertainty in peer review Reduces burden on funders, reviewers and applicants	Potentially politically unpalatable Need to select between a few different practical options for implementation As yet largely untested
Self-review	Applicants review each others' proposals	Reduces burden on funders in identifying reviewers Incentives timely review delivery Draws on wisdom of the crowds	Mechanism needed to ensure there is no gaming of the system
Open peer review	Three levels: open identities, where reviewer and applicant know each other's identities; open report, where application and review published; open interaction, where communication between applicants and reviewers encouraged.	Improve review quality and fairness Increased transparency Scope for learning and sharing of ideas Credit provided to reviewers for their efforts	Open reports may concern applicants in terms of protecting their IP Risk that reviewers are unwilling to be critical Careful consideration of potential unintended consequences of review reward systems required Limited application in funding context – except for sandpits
Broadening participation and crowd-sourcing	Enabling wider participants, such as patients and member of the public, to be involved in peer review	Increased transparency Potential for increased openness to innovation and less cognitive bias Where participants are patients, potential to learn from experiences and build trust and buy-in	Lay reviewers have less technical expertise Engagement of reviewers – may not respond or provide limited input Ensuring equal participation where participating alongside academics
Innovation prizes	Offering a financial reward for achieving a pre-specified goal	Promotes innovative ideas and open to broader range of participants De-risks investment for funder Enables large scale challenges to be addressed	Requires a clearly specified problem Assessment must be clearly delineated and free from bias Does not offer up-front resources which could exclude some from participating
Using new technology	Using new technologies to improve the grant funding process; particularly, using technology to enable virtual peer review panel meetings, to identify reviewers, and to support the assessment of applications.	Burden on funders in organizing panel meetings and identifying reviewers Burden of delivering peer reviews Quality of assessment of novelty and scientific merit	Doesn't address main source of burden – which is on applicants Some technologies not currently adapted for application review Could reinforce existing biases

Endnotes

1. Royal Society; Response to the RCUK consultation on the efficiency and effectiveness of peer review, 2007. https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2007/8090.pdf
2. Smith, R. 'Peer review: reform or revolution?' BMJ 315(7111).; Azoulay, P., "Turn the scientific method on ourselves," Nature, 1997 Vol. 484, 2012, pp. 31–32.
3. Gluckman P: Which science to fund: time to review peer review? New Zealand Office of the Prime Minister's Science Advisory Committee. 2012.; Graves, N., Barnett, A.G., & P. Clarke. 2011. 'Funding grant proposals for scientific research: retrospective analysis of scores by members of grant review panel.' BMJ 343, d4797; Fang, F.C., & A. Casadevall. 2009. 'NIH peer review reform – change we need, or lipstick on a pig?' Infect Immun 77(3), 929–32.
4. Graves, N., Barnett, A. G., & Clarke, P. (2011). Cutting random funding decisions. Nature, 469(7330), 299.
5. Mullard, A. (2011). Reliability of'new drug target'claims called into question. Nature http://blogs.nature.com/news/2011/09/reliability_of_new_drug_target.html; Ioannidis, J. P., Allison, D. B., Ball, C. A., Coulibaly, I., Cui, X., Culhane, A. C., ... & Mangion, J. (2009). Repeatability of published microarray gene expression analyses. Nature genetics, 41(2), 149.; Bell, A. W., Deutsch, E. W., Au, C. E., Kearney, R. E., Beavis, R., Sechi, S., ... & Meredith, G. (2009). A HUPO test sample study reveals common problems in mass spectrometry–based proteomics. Nature methods, 6(6), 423.
6. Chalmers I, Glasziou P. Avoidable waste in the production and reporting of research evidence. Lancet2009;374:86-9. doi:10.1016/S0140-6736(09)60329-9 pmid:19525005
7. Guthrie S, Ghiga I and Wooding S. What do we know about grant peer review in the health sciences? [version 2; peer review: 2 approved]. F1000Research 2018, 6:1335 (https://doi.org/10.12688/f1000research.11917.2)
8. Braben D: Pioneering Research: A Risk Worth Taking. Hoboken, New Jersey: Wiley Interscience. 2004.; Alberts B, Kirschner MW, Tilghman S, et al.: Rescuing US biomedical research from its systemic flaws. Proc Natl Acad Sci U S A. 2014; 111(16): 5773–5777.; Boudreau KJ, Guinan EC, Lakhani KR, et al.: The Novelty Paradox & Bias for Normal Science: Evidence from Randomized Medical Grant Proposal Evaluations. Harvard Business School Working Paper. 2012; 13–053.; Boudreau KJ, Guinan EC, Lakhani KR, et al.: Looking Across and Looking Beyond the Knowledge Frontier: Intellectual Distance, Novelty, and Resource Allocation in Science. Manage Sci. 2016; 62(10): 2765–2783.; Kaplan D: How to improve peer review at N.I.H. Scientist. 2005; 10.; Scarpa T: Research funding: Peer Review at NIH. Science. 2006; 311(5757): 41
9. Danthi N, Wu CO, Shi P, et al.: Percentile ranking and citation impact of a large cohort of National Heart, Lung, and Blood Institute-funded cardiovascular R01 grants. Circ Res. 2014; 114(4): 600–606.; Danthi NS, Wu CO, DiMichele DM, et al.: Citation impact of NHLBI R01 grants funded through the American Recovery and Reinvestment Act as compared to R01 grants funded through a standard payline. Circ Res. 2015; 116(5): 784–788.; Doyle JM, Quinn K, Bodenstein YA, et al.: Association of percentile ranking with citation impact and productivity in a large cohort of de novo NIMH-funded R01 grants. Mol Psychiatry. 2015; 20(9): 1030–1036.; Fang FC, Bowen A, Casadevall A: NIH peer review percentile scores are poorly predictive of grant productivity. eLife. 2016; 5: pii: e13323; Kaltman JR, Evans FJ, Danthi NS, et al.: Prior publication productivity, grant percentile ranking, and topic-normalized citation impact of NHLBI cardiovascular R01 grants. Circ Res. 2014; 115(7): 617–624. ; van den Besselaar P, Sandström U: Early career grants, performance, and careers: A study on predictive validity of grant decisions. J Informetr. 2015; 9(4): 826–838
10. Fogelholm M, Leppinen S, Auvinen A, et al.: Panel discussion does not improve reliability of peer review for medical research grant proposals. J Clin Epidemiol. 2012; 65(1): 47–52.; Jayasinghe UW, Marsh HW, Bond N: A multilevel cross-classified modelling approach to peer review of grant proposals: the effects of assessor and researcher attributes on assessor ratings. J Roy Stat Soc. 2003; 166(3): 279–300.; Pina DG, Hren D, Marusic A: Peer Review Evaluation Process of Marie Curie Actions under EU's Seventh Framework Programme for Research. PLoS One. 2015; 10(6): e0130753
11. Jang D, Doh S, Kang GM, et al.: Impact of Alumni Connections on Peer Review Ratings and Selection Success Rate in National Research. Sci Technol Hum Val. 2016; 42(1): 116–143.; Kaatz A, Gutierrez B, Carnes M: Threats to objectivity in peer review: the case of gender. Trends Pharmacol Sci. 2014; 35(8): 371–373; Kaatz A, Magua W, Zimmerman DR, et al.: A quantitative linguistic analysis of National Institutes of Health R01 application critiques from investigators at one institution. Acad Med. 2015; 90(1): 69–75.; Tamblyn R, McMahon M, Girard N, et al.: Health services and policy research in the first decade at the Canadian Institutes of Health Research. CMAJ Open. 2016; 4(2): E213–21.; van der Lee R, Ellemers N: Gender contributes to personal research funding success in The Netherlands. Proc Natl Acad Sci U S A. 2015; 112(40): 12349–12353.; Volker B, Steenbeek W: No evidence that gender contributes to personal research funding success in The Netherlands: A reaction to van der Lee and Ellemers. Proc Natl Acad Sci U S A. 2015; 112(51): E7036–7037.
12. Jayasinghe UW, Marsh HW, Bond N: Peer review in the funding of research in higher education: The Australian experience. Educ Eval Policy Anal. 2001; 23(4): 343–364; Jayasinghe UW, Marsh HW, Bond N: A multilevel cross-classified modelling approach to peer review of grant proposals: the effects of assessor and researcher attributes on assessor ratings. J Roy Stat Soc. 2003; 166(3): 279–300.; Jang D, Doh S, Kang GM, et al.: Impact of Alumni Connections on Peer Review Ratings and Selection Success Rate in National Research. Sci Technol Hum Val. 2016; 42(1): 116–143.; Lee M, Om K, Koh J: The bias of sighted reviewers in research proposal evaluation: a comparative analysis of blind and open review in Korea. Scientometrics. 2000; 48(1): 99–116.
13. Travis GDL, Collins HM: New light on old boys: cognitive and institutional Particularism in the peer review system. Sci Technol Hum Val. 1991; 16: 322–341.; Fang FC, Casadevall A: NIH peer review reform--change we need, or lipstick on a pig? Infect Immun. 2009; 77(3): 929–932; Boudreau KJ, Guinan EC, Lakhani KR, et al.: Looking Across and Looking Beyond the Knowledge Frontier: Intellectual Distance, Novelty, and Resource Allocation in Science. Manage Sci. 2016; 62(10): 2765–2783.; Gallo SA, Sullivan JH, Glisson SR: The Influence of Peer Reviewer Expertise on the Evaluation of Research Funding Applications. PLoS One. 2016; 11(10): e0165147; Langfeldt L: The policy challenges of peer review: managing bias, conflict of interests and interdisciplinary assessments. Res Eval. 2006; 15(1): 31–41.; Li D: Expertise vs. Bias in Evaluation: Evidence from the NIH. Harvard Business School Working Paper, (No. 16-053). 2015.
14. Wenneras C, Wold A: Nepotism and sexism in peer-review. Nature. 1997; 387(6631): 341–343.; Jang D, Doh S, Kang GM, et al.: Impact of Alumni Connections on Peer Review Ratings and Selection Success Rate in National Research. Sci Technol Hum Val. 2016; 42(1): 116–143.; Bhattacharjee Y: Science funding. NSF's 'Big Pitch' tests anonymized grant reviews. Science. 2012; 336(6084): 969–970
15. Gluckman P: Which science to fund: time to review peer review? New Zealand Office of the Prime Minister's Science Advisory Committee. 2012.; Graves N, Barnett AG, Clarke P: Funding grant proposals for scientific research: retrospective analysis of scores by members of grant review panel. BMJ. 2011; 343: d4797.; Peckham D, Bosompra KN, Manuel C: Evaluation of the Open Operating Grant Program, Final Report. Ottawa: 2012; Kulage KM, Schnall R, Hickey KT, et al.: Time and costs of preparing and submitting an NIH grant application at a school of nursing. Nurs Outlook. 2015; 63(6): 639–649.; Fang FC, Casadevall A: NIH peer review reform--change we need, or lipstick on a pig? Infect Immun. 2009; 77(3): 929–932. Manville, Catriona, Molly Morgan Jones, Michael Frearson, Sophie Castle-Clarke, Marie-Louise Henham, Salil Gunashekar, and Jonathan Grant, Preparing impact submissions for REF 2014: An evaluation: Findings and observations. HEFCE (Higher Education Funding Council for England), 2015. https://www.rand.org/pubs/research_reports/RR727.html.
16. Research Councils UK: Efficiency and Effectiveness of Peer Review. 2006.; Braben D: Pioneering Research: A Risk Worth Taking. Hoboken, New Jersey: Wiley Interscience. 2004.
17. Guthrie, Susan, Ioana Ghiga, and Steven Wooding, What do we know about grant peer review in the health sciences? An updated review of the literature and six case studies. Santa Monica, CA: RAND Corporation, 2018. https://www.rand.org/pubs/research_reports/RR1822.html.

18. Guthrie, Susan, Ioana Ghiga, and Steven Wooding, What do we know about grant peer review in the health sciences? An updated review of the literature and six case studies. Santa Monica, CA: RAND Corporation, 2018. https://www.rand.org/pubs/research_reports/RR1822.html.

19. Fang, F.C., & A. Casadevall. 'NIH peer review reform – change we need, or lipstick on a pig?' Infect Immun 2009, 77(3), 929–32.; Fang, F.C., & A. Casadevall. 'Reforming science: structural reforms.' Infect Immun 2012, 80(3), 897–901.

20. Parks, Sarah, Catriona Manville, Katherine Stewart, Louise Lepetit, Marie-Louise Henham, Miaoqing Yang, and Joanna Chataway, A review of the Hong Kong Research Grants Council. University Grants Committee of Hong Kong (UGC), 2017. https://www.rand.org/pubs/research_reports/RR2289.html.

21. Ioannidis, J. P. (2011). More time for research: fund people not projects. Nature, 477(7366), 529.

22. Pier, E.I., M. Brauer, A. Filut, A. Kaatz, J. Raclaw, M.J. Nathan, C.E. Ford, M. Carnes. Low agreement among reviewers evaluating the same NIH grant applications. Proceedings of the National Academy of Sciences Mar 2018, 115 (12) 2952-2957; DOI: 10.1073/pnas.1714379115; Graves, N., A.G. Barnett, P. Clarke. Funding grant proposals for scientific research: retrospective analysis of scores by members of grant review panel BMJ 2011; 343 :d4797

23. Fang, F.C., & A. Casadevall.. 'Research Funding: the Case for a Modified Lottery.' MBio 2016 7(2), e00422-00416.

24. Avin, S. 'Funding Science by Lottery.' European Studies in Philosophy of Science, 2015, 111–26.

25. Fang, F.C., & A. Casadevall. 'Research Funding: the Case for a Modified Lottery.' MBio 2016, 7(2), e00422-00416.

26. Barnett, A.G. 'Funding by lottery: Political problems and research opportunities.' MBio 2016, 7(4), e01369–16. doi:10.1128/mBio.01369-16

27. http://www.hrc.govt.nz/funding-opportunities/researcher-initiated-proposals/explorer-grants

28. https://gateway.hrc.govt.nz/funding/researcher-initiated-proposals/2020-explorer-grants

29. Brezis, E.S. Focal randomisation: An optimal mechanism for the evaluation of R&D projects, Science and Public Policy, Volume 34, Issue 10, December 2007, Pages 691–698, https://doi.org/10.3152/030234207X265394

30. Graves, N., Barnett, A. G., & Clarke, P. Cutting random funding decisions. Nature, 2011, 469(7330), 299.

31. Ioannidis, J. P. More time for research: fund people not projects. Nature, 2011, 477(7366), 529.

32. Mervis, J. A radical change in peer review. Science Jul 2014 : 248-249

33. Graves N, Barnett AG, Clarke P: Funding grant proposals for scientific research: retrospective analysis of scores by members of grant review panel. BMJ. 2011; 343: d4797; Gluckman P: Which science to fund: time to review peer review? New Zealand Office of the Prime Minister's Science Advisory Committee. 2012.; Barnett AG, Herbert DL, Campbell M, et al.: Streamlined research funding using short proposals and accelerated peer review: an observational study. BMC Health Serv Res. 2015; 15: 55.

34. DeCoursey, T. "The Pros and Cons of Open Peer Review." Nature. 2006. https://doi.org/10.1038/nature04991.

35. Ross-Hellauer T. What is open peer review? A systematic review. F1000Research, 2017, 6, 588. doi:10.12688/f1000research.11369.2

36. Open participation taken this concept a step further, with the wider community able to engage in and contribute to the review process. This is explored further in section 2.4.

37. van Rooyen S, Godlee F, Evans S, Black N, Smith R. Effect of open peer review on quality of reviews and on reviewers' recommendations: a randomised trial. BMJ. 1999 Jan 2; 318(7175):23-7.

38. Bloom T: Referee Report For: What is open peer review? A systematic review [version 1; referees: 1 approved, 3 approved with reservations]. F1000Res. 2017;6:588 10.5256/f1000research.12273.r22301

39. Kelly, J., T. Sadeghieh, and K. Adeli. "Peer Review in Scientific Publications: Benefits, Critiques, & A Survival Guide." EJIFCC 2014, 25 (3): 227–43.; DeCoursey, T. "The Pros and Cons of Open Peer Review." Nature. 2006, https://doi.org/10.1038/nature04991.

40. McNutt RA, Evans AT, Fletcher RH, Fletcher SW. The effects of blinding on the quality of peer review. A randomized trial. JAMA. 1990 Mar 9; 263(10):1371-6.; van Rooyen S, Godlee F, Evans S, Black N, Smith R. Effect of open peer review on quality of reviews and on reviewers' recommendations: a randomised trial. BMJ. 1999 Jan 2; 318(7175):23-7.; van Rooyen S, Delamothe T, Evans SJ. Effect on peer review of telling reviewers that their signed reviews might be posted on the web: randomised controlled trial. BMJ. 2010 Nov 16; 341():c5729.

41. Walsh, E., Rooney, M., Appleby, L., & Wilkinson, G. Open peer review: a randomised controlled trial. The British Journal of Psychiatry, 2000, 176(1), 47-51.

42. Ross-Hellauer T. What is open peer review? A systematic review. F1000Research, 2017, 6, 588. doi:10.12688/f1000research.11369.2

43. Ross-Hellauer T. What is open peer review? A systematic review. F1000Research, 2017, 6, 588. doi:10.12688/f1000research.11369.2

44. Tennant, J.P., J.M. Dugan, D. Graziotin, D.C. Jacques, F. Waldner, D. Mietchen, Y. Elkhatib, L.B. Collister, C.K. Pikas, and T. Crick. "A Multi-Disciplinary Perspective on Emergent and Future Innovations in Peer Review." F1000Research, 2017, 6.

45. Spearpoint, M. "A Proposed Currency System for Academic Peer Review Payments Using the Blockchain Technology." Publications 2017, 5 (3): 19.

46. Jan, Zeeshan. 2018. "Recognition and Reward System for Peer-Reviewers." In , 2181:46–54. CEUR-WS. org.; Janowicz, Krzysztof, Blake Regalia, Pascal Hitzler, Gengchen Mai, Stephanie Delbecque, Maarten Fröhlich, Patrick Martinent, and Trevor Lazarus. 2018. "On the Prospects of Blockchain and Distributed Ledger Technologies for Open Science and Academic Publishing." Semantic Web, no. Preprint: 1–11.

47. Effect on peer review of telling reviewers that their signed reviews might be posted on the web: randomised controlled trial. van Rooyen S, Delamothe T, Evans SJ BMJ. 2010 Nov 16; 341():c5729.

48. Nicholson J, Alperin JP: A Brief Survey on Peer Review in Scholarly Communication. The Winnower,2016.

49. The eLife approach to peer review. Schekman R, Watt F, Weigel D Elife. 2013 Apr 30; 2():e00799.; Hames I: The Changing Face of Peer Review. Sci Ed.Korean Council of Science Editors.2014;1(1):9–12. 10.6087/kcse.2014.1.9

50. For example, the IDEAS Factory initiative of the UK Engineering and Physical Sciences Research Council. https://epsrc.ukri.org/funding/applicationprocess/routes/network/ideas/whatisasandpit/

51. Guthrie, S., Guerin, B., Wu, H., Ismail, S., & Wooding, S. (2013). Alternatives to peer review in research project funding. RAND Report RR-139-DH

52. Ross-Hellauer T. (2017). What is open peer review? A systematic review. F1000Research, 6, 588. doi:10.12688/f1000research.11369.2

53. Bornmann L, Herich H, Joos H, et al. : In Public Peer Review of Submitted Manuscripts How Do Reviewer Comments Differ from Comments Written by Interested Members of the Scientific Community? A Content Analysis of Comments Written for Atmospheric Chemistry and Physics. Scientometrics. Springer Nature. 2012;93(3):915–29. 10.1007/s11192-012-0731-8

54. Fitzpatrick K, Santo A: Open Review, A Study of Contexts and Practices. Report.2012.

55. Patient participation in peer review panels is standard practice for the NIH and the main health research funder in the UK, NIHR, and is becoming increasingly common internationally.

56. E.g. INVOLVE. n.d. "What Is Public Involvement in Research?" https://www.invo.org.uk/find-out-more/what-is-public-involvement-in-research-2/; NIHR, n.d. "Become a reviewer" https://www.nihr.ac.uk/funding-and-support/funding-for-research-studies/become-a-reviewer/; NIMH, n.d. "Applying to be a Public Reviewer" https://www.nimh.nih.gov/funding/grant-writing-and-application-process/applying-to-be-a-public-reviewer.shtml

57. Oliver SR: How can health service users contribute to the NHS research and development programme?. BMJ. 1995, 310: 1318-20.; Entwistle VA, Renfrew MJ, Yearley S, Forrester J, Lamont T: Lay perspectives: advantages for health research. BMJ. 1998, 316: 463-6.
58. Andejeski, Y., Bisceglio, I. T., Dickersin, K., Johnson, J. E., Robinson, S. I., Smith, H. S., ... & Rich, I. M. (2002). Quantitative impact of including consumers in the scientific review of breast cancer research proposals. Journal of women's health & gender-based medicine, 11(4), 379-388.; Manville, Catriona, Susan Guthrie, Marie-Louise Henham, Bryn Garrod, Sonia Sousa, Anne Kirtley, Sophie Castle-Clarke, and Tom Ling, Assessing impact submissions for REF2014: An evaluation. HEFCE (Higher Education Funding Council for England), 2015. https://www.rand.org/pubs/research_reports/RR1032.html.
59. Derrick, Gemma. 2018. "Take Peer Pressure out of Peer Review." Nature 554 (January): 7. https://doi.org/10.1038/d41586-018-01381-y.
60. Monahan A, Stewart DE. The role of lay panelists on grant review panels. Chronic Dis Can. 2003;24(2–3):70–74
61. Agnew B. NIH invites activists into the inner sanctum. Science. 1999;283(5410):1999–2001.; Andejeski Y, Breslau ES, Hart E, et al.. Benefits and drawbacks of including consumer reviewers in the scientific merit review of breast cancer research. J Womens Health Gend Based Med. 2002;11(2):119–136.
62. Ford E: Defining and Characterizing Open Peer Review: A Review of the Literature. J Scholarly Publ.University of Toronto Press Inc. (UTPress),2013;44(4):311–26. 10.3138/jsp.44-4-001; Open peer review at four STEM journals: an observational overview. Ford E F1000Res. 2015; 4():6.
63. Cohen, Philip. 2017. "The next Stage of SocArXiv's Development: Bringing Greater Transparency and Efficiency to the Peer Review Process." Impact of Social Sciences Blog.
64. Sabater-Mir, Jordi, Francisco Grimaldo, and Mario Paolucci. n.d. "Peer Review as a Reputation System."; Rossum, Joris van. 2017. "Blockchain for Research -Perspectives on a New Paradigm for Scholarly Communication." Digital Science. https://doi.org/10.6084/m9.figshare.5607778
65. https://experiment.com/
66. Fitzpatrick K, Santo A: Open Review, A Study of Contexts and Practices. Report.2012.
67. Fitzpatrick K: Planned Obsolescence.New York, NY: NYU Press,2011[
68. E.g. Kremer and Williams., 2010 Michael Kremer, Heidi Williams Incentivizing innovation: adding to the tool kit Innov. Policy Econ., 10 (2010), pp. 1-17; Fiona Murray, Stern Scott, Campbell Georgina, MacCormack Alan Grand innovation prizes: a theoretical, normative and empirical evaluation Res. Policy, 41 (10) (2012), pp. 1779-1792; Petra Moser, Tom Nicholas Prizes, publicity and patents: non-monetary awards as a mechanism to encourage innovation J. Ind. Econ., 6 (3) (2013), pp. 763-788
69. Burton, M. D., & Nicholas, T. (2017). Prizes, patents and the search for longitude. Explorations in Economic History, 64, 21-36.
70. https://fas.org/sgp/obama/wh030810.pdf
71. Murray, F., Stern, S., Campbell, G., & MacCormack, A. (2012). Grand Innovation Prizes: A theoretical, normative, and empirical evaluation. Research Policy, 41(10), 1779-1792.
72. Guthrie, S., Guerin, B., Wu, H., Ismail, S., & Wooding, S. (2013). Alternatives to peer review in research project funding.
73. Guthrie, S., Guerin, B., Wu, H., Ismail, S., & Wooding, S. (2013). Alternatives to peer review in research project funding.
74. Murray, F., Stern, S., Campbell, G., & MacCormack, A. (2012). Grand Innovation Prizes: A theoretical, normative, and empirical evaluation. Research Policy, 41(10), 1779-1792
75. L. Kay The effect of inducement prizes on innovation R&D Management, 41 (4) (2011), pp. 360-377
76. Kremer, Michael, and Heidi Williams. 2010. "Incentivizing Education: Adding to the Toolkit." Innovation Policy and the Economy 10 (1): 1-17.
77. BOSTON CONSULTING GROUP. (2015). The Advance Market Commitment Pilot for Pneumococcal Vaccines: Outcomes and Impact Evaluation. https://www.gavi.org/results/evaluations/pneumococcal-amc-outcomes-and-impact-evaluation/
78. Gallo, S.A., Carpenter, A.S., & S.R. Glisson. 2013. 'Teleconference versus face-to-face scientific peer review of grant application: effects on review outcomes.' PLoS One 8(8), e71693.
79. Pier, E.L., Raclaw, J., Nathan, M.J., Kaatz, A., Carnes, M., & C.E. Ford. 2015. Studying the study section: How group decision making in person and via videoconferencing affects the grant peer review process. Working Paper No. 2015-6. Madison: Wisconsin Center for Education Research.
80. Bohannon, J. 2011. 'National Science Foundation. Meeting for peer review at a resort that's virtually free.' Science 331(6013), 27. doi:10.1126/science.331.6013.27
81. Pier, E.L., Raclaw, J., Nathan, M.J., Kaatz, A., Carnes, M., & C.E. Ford. 2015. Studying the study section: How group decision making in person and via videoconferencing affects the grant peer review process. Working Paper No. 2015-6. Madison: Wisconsin Center for Education Research.
82. Bohannon, J. 2011. 'National Science Foundation. Meeting for peer review at a resort that's virtually free.' Science 331(6013), 27. doi:10.1126/science.331.6013.27
83. Flach, Peter A, Sebastian Spiegler, and Bruno Gol. 2010. "Novel Tools to Streamline the Conference Review Process: Experiences from SIGKDD'09" 11 (2): 5
84. Price, Simon, Peter A. Flach, Sebastian Spiegler, Christopher Bailey, and Nikki Rogers. 2013. "SubSift Web Services and Workflows for Profiling and Comparing Scientists and Their Published Works." Future Generation Computer Systems 29 (2): 569–81.
85. Arunachalam, N., E. Sathya, S. Hismath Begum, and M. Uma Makeswari. 2013. "An Ontology Based Text Mining Framework for R&D Project Selection." International Journal of Computer Science & Information Technology 5 (1): 161.; Patil, Snehal Shivaji, and S. A. Uddin. 2015. "Research Paper Selection Based on an Ontology and Text Mining Technique Using Clustering." J Comput Eng 17 (1): 65–71.; Srivastava, Ratish, and A. B. Bagwan. 2015. "Classification and Assignment of Research Papers Using Ontology Based Hybrid Approach."
86. Gluckman, P., M. Ferguson, A. Glover, J. Grant, T. Groves, M. Lauer and M. Ulfendahl (2017) International peer review expert panel report: A report to the Governing Council of the Canadian Institutes of Health Research. Available at: http://www.cihr-irsc.gc.ca/e/50248.html
87. Parks et al. (Forthcoming) The changing research landscape and reflections on national research assessment in the future. Research England
88. https://www.turnitin.com/
89. http://www.statreviewer.com/
90. https://unsilo.ai/
91. Ioannidis, J. P. (2011). More time for research: fund people not projects. Nature, 477(7366), 529.
92. Smith, Elta, Sarah Parks, Salil Gunashekar, Catherine A. Lichten, Anna Knack, and Catriona Manville, Open Science: The citizen's role and contribution to research. Santa Monica, CA: RAND Corporation, 2017. https://www.rand.org/pubs/perspectives/PE246.html.
93. Emanuel, E. J. (2013). The future of biomedical research. JAMA, 309(15), 1589-1590.
94. Herbert, D.L,, Coveney, J., Clarke, P., et al. 2014. The impact of funding deadlines on personal workloads, stress and family relationships: a qualitative study of Australian researchers. BMJ Open, 4, e004462. doi:10.1136/bmjopen-2013-004462

ABOUT THE AUTHOR

Susan Guthrie is a research leader at RAND Europe. Her primary research interests are in the area of science and innovation policy, with a particular interest in evaluation, performance monitoring, and research strategy.

SUGGESTED CITATION

Guthrie, S. “Innovating in the Research Funding Process: Peer Review Alternatives and Adaptations,” AcademyHealth, November 2019.