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Title

Using simplified peer review processes to fund research: a prospective study

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ABSTRACT

Objective: To prospectively test two simplified peer review processes, estimate the agreement between the simplified and official processes, and compare the costs of peer review.

Design, participants and setting: A prospective parallel study of Project Grant proposals submitted in 2013 to the National Health and Medical Research Council (NHMRC) of Australia. The official funding outcomes were compared with two simplified processes using proposals in Public Health and Basic Science. The two simplified processes were: panels of 7 reviewers who met face-to-face and reviewed only the nine-page research proposal and track record (simplified panel); and 2 reviewers who independently reviewed only the nine-page research proposal (journal panel). The official process used panels of 12 reviewers who met face-to-face and reviewed longer proposals of around 100 pages. We compared the funding outcomes of 72 proposals that were peer reviewed by the simplified and official processes.

Main outcome measures: Agreement in funding outcomes; costs of peer review based on reviewers' time and travel costs.

Results: The agreement between the simplified and official panels (72%, 95% CI 61–82%), and the journal and official panels (74%, 62–83%), was just below the acceptable threshold of 75%. Using the simplified processes would save \$A2.1 to \$A4.9 million per year in peer review costs.

Conclusions: Using shorter applications and simpler peer review processes gave reasonable agreement with the more complex official process. Simplified processes save time and money that could be re-allocated to actual research. We recommend that the NHMRC further simplify their application processes.

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Strengths and limitations

- This is the first study to prospectively test a simplified funding application process.
- Simplified peer review processes save time and resources that could be spent on actual research.
- Our results indicate that the current lengthy process could be simplified without impacting greatly on funding outcomes.
- The sample size was small, and this is because of the costs involved in the additional peer review.

INTRODUCTION

Funding agencies use peer review to identify which proposals to fund, but the evidence for the effectiveness of peer review for funding research is lacking.¹ Large costs are incurred in assembling the people and information required to allocate research funding² including: the applicants' time spent preparing a proposal,³⁻⁵ the peer reviewers' time,⁶⁻⁸ and the administrative burden on institutions and funding agencies.⁸⁻¹⁰ Our previous research estimated that 547 working years of researchers' time (\$66 million in salary costs) was spent preparing for Project Grant proposals for the National Health and Medical Research Council.³, and two years later this had increased to 614 working years.¹¹ It could be possible to reduce these application high costs without negatively impacting on funding decisions.

The peer review of funding proposals is labour intensive. Most funding agencies use face-to-face meetings combined with prior assessment from panel members and external reviewers, e.g., Canadian Institutes of Health Research,¹² Engineering and Physical Science Research Council (UK),¹³ Medical Research Council (UK),¹⁴ National Institutes of Health (USA),¹⁵ and the National Science Foundation (USA).¹⁶ Proposals are long and detailed and take time to prepare and assess. A simplified funding system would give researchers, as applicants or peer reviewers, more time for their research, an issue recognised more than three decades ago.^{17, 18}

Changes to a funding peer review process need to be evaluated in terms of the change in funding outcomes and change in costs. For funding outcomes the key measure is the agreement between the changed process and the official process. Only a handful of studies have experimentally examined the agreement of funding processes. In 1977 the US National Science Foundation re-reviewed 150 proposals using a second independent peer review panel

and found a 24–30% disagreement in funding outcomes.¹⁷ A Canadian study of 248 proposals submitted to two major funding agencies with similar peer review processes found a 27% disagreement in funding.¹⁹ In 2009 the Academy of Finland randomly assigned peer reviewers to two panels assessing the same 65 proposals, and found a 31–35% disagreement.²⁰ These studies have a 65–76% agreement and 24–35% disagreement. We similarly found that a 75% agreement was the median acceptable agreement for funding peer review in a survey of Australian researchers based on a hypothetical peer review scenario.³ The scenario was that researchers were asked to imagine that 100 Project Grants had been assessed and that 20 had been funded, and then asked them how many of these 20 they would want to be selected by a second independent panel.

The objective of this study is to prospectively test shortened proposals and simplified peer review processes for the main funding scheme of the National Health and Medical Research Council of Australia (NHMRC). This involved the parallel assessment of actual proposals submitted to the NHMRC’s Project Grant scheme in 2013. There were 3,821 Project Grant proposals and the success rate was 16.9% with a total budget of \$A419.6 million. We aimed to identify the agreement between the official process and two simplified processes, and the peer review cost savings for the simplified processes.

METHODS

Study design

This study uses data from Simplified and Journal peer review panels organised by the research team (Figure 1), and the official NHMRC panels for Project Grant proposals. The study was approved by the Queensland University of Technology Ethics Committee.

Proposals

The target research areas were Basic Science and Public Health. These areas were selected based on the findings from a NHMRC study that identified high (Basic Science) and low (Public Health) correlations between the track record scores from the official panels in 2001 and the corresponding bibliometric measures.²¹ These two fields were therefore chosen with the aim of examining the widest expected range in agreement.

A sample of 72 Project proposals submitted to the NHMRC in March 2013 was voluntarily provided to the team by Australian researchers in response to email invitations sent through our existing contacts from previous studies. We used our contacts rather than a random sample of researchers in order to reduce the administrative costs of running the study. This may impact on our sample's representativeness, although our contacts covered most Australian cities and a wide range of research institutes. The lead researchers provided our team with their proposals (March–April 2013), and their official NHMRC scores (October–November 2013). The provision of the proposal from the lead researcher was accepted as consent to participate.

Simplified panels

For the official NHMRC process, panel members assessed proposals that were around 100 pages long. We used a simplified process where panel members reviewed a shortened proposal which included the 9-page research plan and a 2-page track record for each Chief Investigator. A list of sections used in Table 1. The Simplified panels were convened by our research team in June 2013 before the Official panels (July–September 2013). Our findings had no bearing on the official awarding of funding in October 2013. Members of the

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Table 1 Sections of the Project Grant application used by the official NHMRC peer review processes (in 2013 and 2014) and the simplified processes

Section	NHMRC 2013	Simplified panel	Journal panel	NHMRC 2014
Research Proposal (9 pages)	✓	✓	✓	✓
Associate Investigator (AI) Contribution	✓	✓		
References	✓	✓	✓	✓
Progress reports	✓			
Team track record	✓			✓
2 page Track Record per CI	✓	✓		✓
Career disruption	✓	✓		✓
Application summary	✓	✓		✓
Synopsis	✓	✓	✓	✓
Application Information	✓			✓
Participation	✓			
Research Team	✓			✓
Qualifications	✓			
Awards and Prizes	✓			
Employment History (last 10 years only)	✓			
Publications, Papers, Reports & Contribution	✓			
Publications (last 5 years only)	✓			✓
Patents	✓			
Translation into Policy / Practice (last 5 years only)	✓			
NHMRC Research Funding (last 5 years only)	✓			
Other Research Funding (last 5 years only)	✓			
Intended NHMRC Funding Requests	✓			
Intended Other Funding Requests	✓			
Workload (Current)	✓			
Research Team: % NHMRC Research Time – This Application	✓			
Research Team: % NHMRC Research Time – Other Applications	✓			
Salary Budget Summary	✓			✓
Total Budget Summary	✓			✓
Aboriginal & Torres Strait Islander Research	✓			
CI Time Commitment				✓

Simplified panel did not participate in the Official panels, but they may have participated as external reviewers for other proposals. Most panel members had senior academic appointments of Professor or Associate Professor, and had prior experience of being a NHMRC peer reviewer (Table 2). Panel members provided written consent to participate, signed a confidentiality agreement and were paid an honorarium for their participation. The payment of travel expenses, accommodation and an honorarium is standard policy for the Official panels to attend a face-to-face meeting.

Table 2 Summary statistics on the characteristics of 16 members of the simplified panel and 16 members of the journal panel

Characteristic	Simplified panel	Journal panel
Female, n (%)	8 (50%)	6 (38%)
Previous experience with NHMRC panel, n (%)	9 (56%)	10 (63%)
Previous external reviewer for NHMRC, n (%)	14 (88%)	14 (88%)
Group of Eight university, n (%)	8 (50%)	9 (56%)
Number of previously submitted NHMRC Project Grant applications, median (IQR)	10 (3–18)	NA

Each 7-person Simplified panel reviewed either 36 Basic Science or 36 Public Health proposals in separate 1.5 day face-to-face meetings. Each panel member was a spokesperson for five or six proposals, and they gave an opening summary of the strengths and weaknesses of the proposal. The panel was allowed a maximum of 15 minutes to discuss each proposal. Before the discussion the panel chair asked all panel members if they had any real or perceived conflicts; the conflict rules were used to match the official peer review process. All scores were given by written secret ballot, and there was no group discussion of the scores.

Journal panels

The Journal panels were designed to work like most journals, where the decision to publish is based on the results of two or more independent reviewers. We used two Journal panel reviewers per proposal, who only considered the 9-page research plan, reference list and synopsis (Table 1). Each panel member reviewed and scored either six or twelve proposals (May–August 2013). Proposals were assigned to reviewers based on their expertise in Basic Science or Public Health and an absence of conflicts of interest.

Simplified peer review

The Official panels rank proposals using a weighted calculation using three criteria-based integer scores (from a low 1 to a high 7) for scientific quality, significance and innovation, and track record. The scores are used to determine an overall ranking and the highest ranked proposals are awarded funding within the budget limitations. Despite the 7-point scale, proposals typically receive one of three category scores. For example, in 2013 almost all proposals scored a 4, 5 or 6 (94.8%); the highest category of 7 (0.1%) and lowest categories of 3 (4.9%), 2 (0.2%) or 1 (nil) are rarely or never used.

We used a simplified scoring process where panel members rated each proposal as: definitely fund, possibly fund, or definitely do not fund. This simplified score is designed to help peer reviewers focus on the actual decision, rather than an esoteric criteria-based scoring system which is a step removed from the final decision and has been described as oblique by some reviewers.²² We awarded funding in our Simplified panel if 50% or more of the 7-person panel recommended ‘definitely fund’, and for our Journal panel if both external reviewers recommended ‘definitely fund’.

Statistical analysis

Cross-tabulations were used to examine the agreement between the Simplified and Official panels for the dichotomous funding outcomes (yes or no). The main outcome is the percentage agreement in funding, for which confidence intervals were generated using a bootstrap algorithm. We use agreement because our aim was to find processes that were as good as the official process but with lower costs. Our previous survey of Australian researchers found the median threshold (from 145 responses) of acceptable agreement for two hypothetical review panels assessing the same proposals was 75%, therefore this level is a meaningful threshold for interpreting acceptable agreement.³ We apply this threshold to the percentage agreement without adjusting for chance agreement, as this is the agreement that would be observed in practice.

Data on time spent and travel were used to estimate the costs of peer review. Members of the Simplified panels reported their time spent reviewing the 36 proposals in preparation for the face-to-face meeting, and their time spent preparing a spokesperson report for each allocated proposal. Travel and accommodation costs to convene the face-to-face meetings were also included. The Journal panel reported on their time spent reviewing each proposal.

The R package (version 3.0.2) was used for all analyses.

RESULTS

Agreement between the simplified and official processes

The mean agreement between the Simplified and Official panels (72%, 95% CI 61–82%), and the Journal and Official panels (74%, 62–83%), was just below the acceptable threshold of 75% (Table 3). The agreement about which proposals to fund was lower than the

agreement about which proposals not to fund. This is partly because many more proposals were not funded than funded. The agreement between the simplified and official processes was slightly lower for Basic Science than for Public Health. The mean agreement between the two simplified panels (79%, 68–89%) was above the 75% threshold (Table 4).

Table 3 Comparison of proposals funded by the Simplified or Journal panels, with the official funding agency (National Health and Medical Research Council of Australia, NHMRC)

Funded by simplified peer review process						
Simplified panels	Basic Science		Public Health		Total	
	n=36		n=36		n=72	
	Yes	No	Yes	No	Yes	No
Funded by NHMRC	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Yes	4 (11)	7 (19)	2 (6)	2 (6)	6 (8)	9 (13)
No	4 (11)	21 (58)	7 (19)	25 (69)	11 (15)	46 (64)
	% (95% CI)		% (95% CI)		% (95% CI)	
Agreement	69 (56, 83)		75 (61, 89)		72 (61, 82)	
Disagreement	31 (17, 44)		25 (11, 39)		28 (18, 39)	
Journal panels	Basic Science		Public Health		Total	
	n=36		n=36		n=72	
	Yes	No	Yes	No	Yes	No
Funded by NHMRC	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Yes	1 (3)	10 (28)	0 (0)	4 (11)	1 (1)	14 (19)
No	3 (8)	22 (61)	2 (6)	30 (83)	5 (7)	52 (72)
	% (95% CI)		% (95% CI)		% (95% CI)	
Agreement	64 (47, 78)		83 (69, 94)		74 (62, 83)	
Disagreement	36 (22, 53)		17 (6, 31)		26 (17, 38)	

Table 4 Comparison of proposals funded by the Simplified panels and Journal panels

	Funded by simplified panel					
	Basic Science		Public Health		Total	
	n=36		n=36		n=72	
	Yes	No	Yes	No	Yes	No
Funded by Journal	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Yes	2 (6)	2 (6)	2 (6)	0 (0)	4 (6)	2 (3)
No	6 (17)	26 (72)	7 (19)	27 (75)	13 (18)	53 (74)
	% (95% CI)		% (95% CI)		% (95% CI)	
Agreement	78 (64, 92)		81 (67, 92)		79 (68, 89)	
Disagreement	22 (8, 36)		19 (8, 33)		21 (11, 31)	

Time spent on simplified peer review

Twice the amount of time was spent reviewing a Basic Science proposal compared with a Public Health proposal (Table 5), possibly due to the technical nature of Basic Science proposals. Similar amounts of time were spent preparing a spokesperson report for the Simplified panel or a Journal panel review. The Simplified panel peer review cost \$A1109 per proposal, including the costs to attend at a face-to-face meeting. The peer review cost for the Journal panel dropped to \$A359 per proposal because of the smaller number of reviewers and absence of travel and accommodation costs. The majority of these costs come from the reviewers' time.

We previously estimated the costs of peer review for the 2009 official funding round to be \$A4.44 million for 2,983 proposals.²³ Based on these figures the cost per proposal in 2013 would be \$A1649 (adjusted for inflation). Hence the estimated cost of running the official

peer review process in 2013 for 3,821 proposals is \$A6.3 million. In comparison, the estimated cost of reviewing the same number of proposals using the Simplified panels is \$A4.2 million and the Journal panels is \$A1.4 million. This gives estimated savings of \$A2.1 to \$A4.9 million per year from using our simplified.

Table 5 Time spent on peer review and cost per proposal, by research area

Simplified panel		Cost per proposal				
		Preparation			Attendance	
		Review	Spokesperson report		Expenses	
Proposals	n	Time, hr	Salary, \$	Time, hr	Salary, \$	\$
Basic Science	36	4.3	434	2.2	204	548
Public Health	36	3.5	390	1.2	115	525
Total	72	3.9	412	1.7	160	537
Journal panel		Two external reviews				
Proposals	n	Time, hr	Salary, \$			
Basic Science	36	4.7	465			
Public Health	36	2.4	252			
Total	72	3.6	359			

Expenses (\$) include salary, airfares, transport, accommodation, catering, honorarium.

DISCUSSION

Using shortened proposals and simplified peer review processes gave a close to adequate agreement with the official NHMRC panels. The NHMRC streamlined the application

process for the 2014 round and removed many sections (Table 1). Our results indicate that this streamlining would not have greatly altered funding outcomes.

By examining the agreement of the streamlined systems with the current system we imply that the current system is a “gold standard”, but the number of peer reviewers per proposal needed to provide anything like a gold standard is in the thousands,²⁴ whereas the current system uses around 12 reviewers per proposal. Despite this, our aim was to show reasonable agreement with the current system in terms of funding, but for lower costs. In other words, we aimed to find an equally imperfect system, but with lower costs. We chose funding as the key (binary) outcome, rather than continuous outcomes such as scores, because funding is what matters most to applicants.

A key strength of this study was the rare opportunity to convene experimental peer review panels to assess actual proposals in parallel with the official process. Our relatively small sample size of 72 proposals is comparable to a Finnish study of 65 proposals using two panels.²⁰ Large sample sizes are difficult in this field because of the high costs of using face-to-face meetings.

The success rate for our sample of Basic Science proposals was higher than the official success rate (31% vs 19%), and for Public Health the success rate was lower (11% vs 13%), indicating some difference in the calibre of the study proposals with the wider population of proposals.²⁵ The much higher success rate in Basic Science may be because the researchers who were willing to provide their proposals for experimental peer review were more senior.

We expect there to be more consensus in funding decisions for the best and worst proposals.^{22, 26} A related study of journal peer review found the agreement for paper publication was twice as likely for the *rejection* of an article compared with acceptance.²⁷ The agreement found in this study is comparable to the small number of other studies of observed agreement (65–76%) when comparing similar or identical peer review systems.¹⁸⁻²⁰ Most researchers understand that peer review processes are unlikely to ever achieve perfect agreement, as even identical peer review processes will give different funding outcomes because of the inherent variability due to subjectivity in peer review.^{7, 23}

Simplified application processes should save time for researchers as applicants and peer reviewers. In this study we only examined the costs saved by peer review which were between \$A2.1 to \$A4.9 million per year thanks to reduced travel costs and reviewer time. Our previous research estimated the majority of costs for the NHMRC Project Grant scheme were for applicants (85%), with the remainder by peer reviewers (9%) and administrators (5%).²³ The high applicant costs are due to an average application time of 34 working days. Simplified processes should take less application time and hence save even more costs, although surprisingly our recent research found that time spent on applications increased after the application process was simplified.¹¹

The Journal panel did not include track record but still had reasonable agreement with the official process. This could be because researchers with strong track records are more experienced at writing proposals. An application without track record would save potentially large amounts of application time because each researcher needs to write a two-page CV and keep their publication information up-to-date in the online system.

Everyone would gain from simplified peer review systems that are cheaper: the funding agencies, institutions, and the researchers as applicants and peer reviewers. Funding agencies around the world face the challenge of a static or diminishing pool of funds to allocate to researchers. A way to increase the amount of money allocated to research is to improve the efficiency of the process and return the cost savings to the funding pool. Our simplified peer review process can save costs and researchers' time, and provide estimated savings of \$A2.1 to \$A4.9 million that could be used to fund additional proposals or spend on actual research. The NHMRC has started a Streamlining Application and Assessment Project,²⁸ and the most recent federal budget assigned \$9.9 million over five years from 2014–15 to “develop a nationally consistent approach to the way clinical research trials are overseen and conducted and to streamline and simplify National Health and Medical Research Council grant application and assessment processes”.²⁹ Our results indicate that a very low cost journal-style system with short applications that do not use track record could potentially replace the current more complex and costly system.

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Competing Interests None declared.

Contributors DLH, NG, PC and AGB designed the study. DLH led the data collection with input from NG and AGB. AGB led the data analysis with input from DLH, NG and PC. DLH, NG, PC and AGB helped interpret the results. DLH wrote the first draft of the manuscript with input from NG, PC and AGB. AGB is the study chief investigator and guarantor.

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Ethics approval Queensland University of Technology Ethics Committee.

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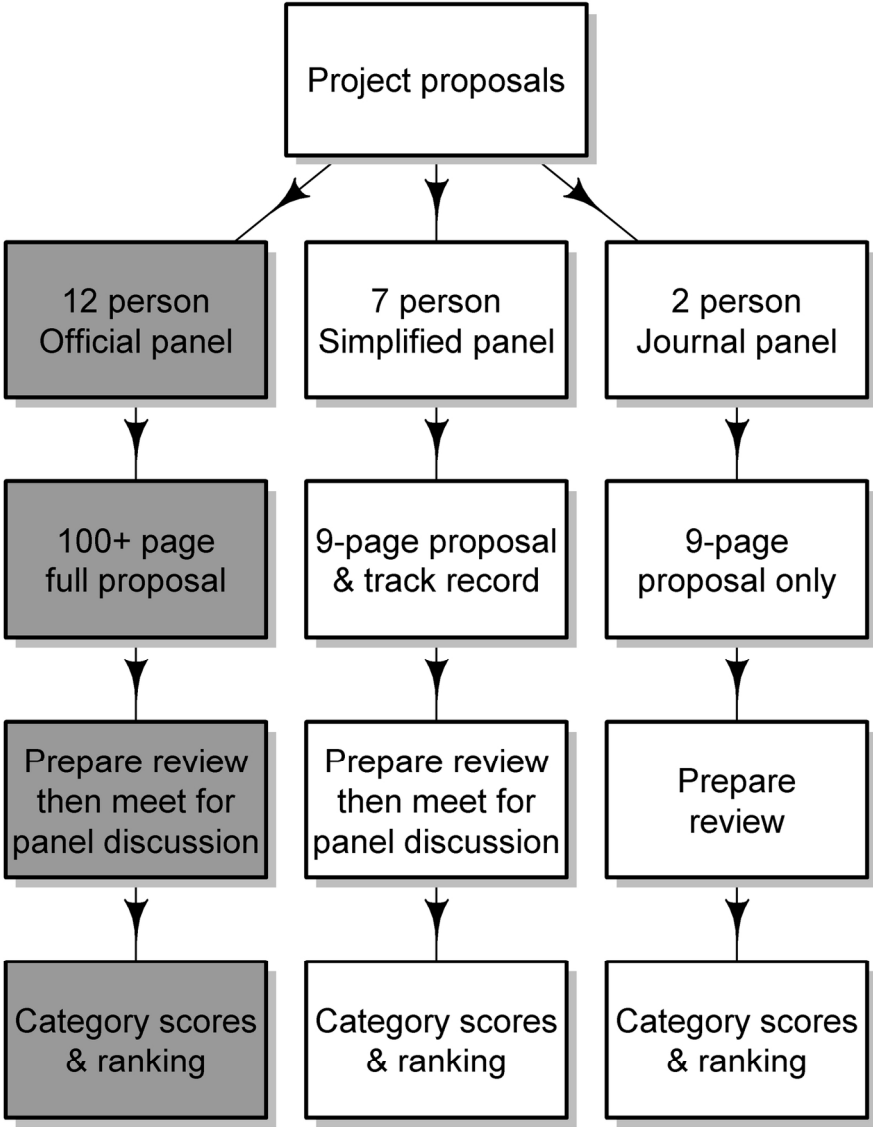
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Study design for shortened proposals and simplified peer review processes. The official funding process (shown in grey) was independent of this study.
152x182mm (300 x 300 DPI)



CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	Not applicable
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	2
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	4-5
	2b	Specific objectives or hypotheses	5
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	5-6, 8-9, Figure 1
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	No changes
Participants	4a	Eligibility criteria for participants	6, 8, 9
	4b	Settings and locations where the data were collected	6, 8, 9
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	6, 8, 9
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	9, 10
	6b	Any changes to trial outcomes after the trial commenced, with reasons	No changes
Sample size	7a	How sample size was determined	6, 15
	7b	When applicable, explanation of any interim analyses and stopping guidelines	Not applicable
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	Not applicable
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Not random
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Not applicable
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Not applicable

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2	Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	Not applicable
3				
4		11b	If relevant, description of the similarity of interventions	Not relevant
5	Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	10
6		12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	10
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9	Results			
10	Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	Figure 1
11		13b	For each group, losses and exclusions after randomisation, together with reasons	Not applicable
12	Recruitment	14a	Dates defining the periods of recruitment and follow-up	6
13		14b	Why the trial ended or was stopped	Not applicable
14	Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Table 2
15	Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	Tables 3 & 4
16				
17	Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Tables 3 & 4
18		17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	Absolute only - Tables 3 & 4
19				
20	Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	Table 5
21	Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	Not applicable
22				
23	Discussion			
24	Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	14-15
25	Generalisability	21	Generalisability (external validity, applicability) of the trial findings	6, 15
26	Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	14-16
27				
28	Other information			
29	Registration	23	Registration number and name of trial registry	Not applicable
30	Protocol	24	Where the full trial protocol can be accessed, if available	Not applicable
31	Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	16
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Using simplified peer review processes to fund research: a prospective study

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Title

Using simplified peer review processes to fund research: a prospective study

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ABSTRACT

Objective: To prospectively test two simplified peer review processes, estimate the agreement between the simplified and official processes, and compare the costs of peer review.

Design, participants and setting: A prospective parallel study of Project Grant proposals submitted in 2013 to the National Health and Medical Research Council (NHMRC) of Australia. The official funding outcomes were compared with two simplified processes using proposals in Public Health and Basic Science. The two simplified processes were: panels of 7 reviewers who met face-to-face and reviewed only the nine-page research proposal and track record (simplified panel); and 2 reviewers who independently reviewed only the nine-page research proposal (journal panel). The official process used panels of 12 reviewers who met face-to-face and reviewed longer proposals of around 100 pages. We compared the funding outcomes of 72 proposals that were peer reviewed by the simplified and official processes.

Main outcome measures: Agreement in funding outcomes; costs of peer review based on reviewers' time and travel costs.

Results: The agreement between the simplified and official panels (72%, 95% CI 61–82%), and the journal and official panels (74%, 62–83%), was just below the acceptable threshold of 75%. Using the simplified processes would save \$A2.1 to \$A4.9 million per year in peer review costs.

Conclusions: Using shorter applications and simpler peer review processes gave reasonable agreement with the more complex official process. Simplified processes save time and money that could be re-allocated to actual research. Funding agencies should consider streamlining their application processes.

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Strengths and limitations

- This is the first study to prospectively test a simplified funding application process.
- Simplified peer review processes save time and resources that could be spent on actual research.
- The current lengthy process could be simplified without impacting greatly on funding outcomes by using a simplified panel.
- The sample size was small, and this is because of the costs involved in the additional peer review.

INTRODUCTION

Funding agencies use peer review to identify which proposals to fund, but the evidence for the effectiveness of peer review for funding research is lacking.¹ Large costs are incurred in assembling the people and information required to allocate research funding² including: the applicants' time spent preparing a proposal,³⁻⁵ the peer reviewers' time,⁶⁻⁸ and the administrative burden on institutions and funding agencies.⁸⁻¹⁰ Our previous research estimated that 547 working years of researchers' time (\$66 million in salary costs) was spent preparing for Project Grant proposals for the National Health and Medical Research Council.³, and two years later this had increased to 614 working years.¹¹ It could be possible to reduce these high application costs without negatively impacting on funding decisions.

The peer review of funding proposals is labour intensive. Most funding agencies use face-to-face meetings combined with prior assessment from panel members and external reviewers, e.g., Canadian Institutes of Health Research,¹² Engineering and Physical Science Research Council (UK),¹³ Medical Research Council (UK),¹⁴ National Institutes of Health (USA),¹⁵ and the National Science Foundation (USA).¹⁶ Proposals are long and detailed and take time to prepare and assess. A simplified funding system would give researchers, as applicants or peer reviewers, more time for their research, an issue recognised more than three decades ago.^{17, 18}

Changes to a funding peer review process need to be evaluated in terms of the change in funding outcomes and change in costs. For funding outcomes the key measure is the agreement between the changed process and the official process. Only a handful of studies have experimentally examined the agreement of funding processes. In 1977 the US National Science Foundation re-reviewed 150 proposals using a second independent peer review panel

and found a 24–30% disagreement in funding outcomes.¹⁷ A Canadian study of 248 proposals submitted to two major funding agencies with similar peer review processes found a 27% disagreement in funding.¹⁹ In 2009 the Academy of Finland randomly assigned peer reviewers to two panels assessing the same 65 proposals, and found a 31–35% disagreement.²⁰ These studies have a 65–76% agreement and 24–35% disagreement. We similarly found that a 75% agreement was the median acceptable agreement for funding peer review in a survey of Australian researchers based on a hypothetical peer review scenario.³ The scenario was that researchers were asked to imagine that 100 proposals had been assessed and that 20 had been funded, and then asked them how many of these 20 they would want to be selected by a second independent panel.

The objective of this study is to prospectively test shortened proposals and simplified peer review processes for the main funding scheme of the National Health and Medical Research Council of Australia (NHMRC). This involved the parallel assessment of actual proposals submitted to the NHMRC’s Project Grant scheme in 2013. There were 3,821 Project Grant proposals and the success rate was 16.9% with a total budget of \$A419.6 million. We aimed to identify the agreement between the official process and two simplified processes, and the peer review cost savings for the simplified processes.

METHODS

Study design

This study uses data from Simplified and Journal peer review panels organised by the research team (Figure 1), and the official NHMRC panels for Project Grant proposals. The study was approved by the Queensland University of Technology Ethics Committee.

Proposals

The target research areas were Basic Science and Public Health. These areas were selected based on the findings from a NHMRC study that identified high (Basic Science) and low (Public Health) correlations between the track record scores from the official panels in 2001 and the corresponding bibliometric measures.²¹ These two fields were therefore chosen with the aim of examining the widest expected range in agreement.

A sample of 72 Project proposals submitted to the NHMRC in March 2013 was voluntarily provided to the team by Australian researchers in response to email invitations sent through our existing contacts from previous studies. We used our contacts rather than a random sample of researchers in order to reduce the administrative costs of running the study. This may impact on our sample's representativeness, although our contacts covered most Australian cities and a wide range of research institutes. The lead researchers provided our team with their proposals (March–April 2013), and their official NHMRC scores (October–November 2013). The provision of the proposal from the lead researcher was accepted as consent to participate.

Official panels

For the official NHMRC process there were 43 panels each with twelve members. During a week-long face-to-face meeting they assessed an average of 91 proposals, each of which was around 100 pages long. Prior to the meeting proposals were scored by two or more independent reviewers. Based on these scores the lowest 33% of applications were labelled “not for further consideration” unless a panel member wanted to rescue them. The remaining applications were discussed in the meeting. Each proposal was summarised by a primary spokesperson, followed by a wider panel discussion, followed by scoring. Conflicted panel

members did not participate in the discussion or scoring. The mean score was used to create a rank and the proposals were funded in rank order until the budget ran out. The key outcome for our study is funded (yes or no).

Simplified panels

We used a simplified process where panel members reviewed a shortened proposal which included the 9-page research plan and a 2-page track record for each Chief Investigator. A list of sections used in Table 1. The Simplified panels were convened by our research team in June 2013 before the Official panels (July–September 2013). Our findings had no bearing on the official awarding of funding in October 2013. Members of the

Table 1 Sections of the Project Grant application used by the official NHMRC peer review processes (in 2013 and 2014) and the simplified processes

Section	NHMRC 2013	Simplified panel	Journal panel	NHMRC 2014
Research Proposal (9 pages)	✓	✓	✓	✓
Associate Investigator (AI) Contribution	✓	✓		
References	✓	✓	✓	✓
Progress reports	✓			
Team track record	✓			✓
2 page Track Record per CI	✓	✓		✓
Career disruption	✓	✓		✓
Application summary	✓	✓		✓
Synopsis	✓	✓	✓	✓
Application Information	✓			✓
Participation	✓			
Research Team	✓			✓
Qualifications	✓			
Awards and Prizes	✓			
Employment History (last 10 years only)	✓			
Publications, Papers, Reports & Contribution	✓			
Publications (last 5 years only)	✓			✓
Patents	✓			
Translation into Policy / Practice (last 5 years only)	✓			
NHMRC Research Funding (last 5 years only)	✓			
Other Research Funding (last 5 years only)	✓			
Intended NHMRC Funding Requests	✓			
Intended Other Funding Requests	✓			
Workload (Current)	✓			
Research Team: % NHMRC Research Time – This Application	✓			
Research Team: % NHMRC Research Time – Other Applications	✓			
Salary Budget Summary	✓			✓
Total Budget Summary	✓			✓
Aboriginal & Torres Strait Islander Research	✓			
CI Time Commitment				✓

Simplified panel did not participate in the Official panels, but they may have participated as external reviewers for other proposals.

Panel members provided written consent to participate, signed a confidentiality agreement and were paid an honorarium for their participation. The payment of travel expenses, accommodation and an honorarium is standard policy for the Official panels to attend a face-to-face meeting.

Each 7-person Simplified panel reviewed either 36 Basic Science or 36 Public Health proposals in separate 1.5 day face-to-face meetings. Each panel member was a spokesperson for five or six proposals, and they gave an opening summary of the strengths and weaknesses of the proposal. The panel was allowed a maximum of 15 minutes to discuss each proposal. Before the discussion the panel chair asked all panel members if they had any real or perceived conflicts; the conflict rules were used to match the official peer review process. All scores were given by written secret ballot, and there was no group discussion of the scores.

Journal panels

The Journal panels were designed to work like most journals, where the decision to publish is based on the results of two or more independent reviewers. We used two Journal panel reviewers per proposal, who only considered the 9-page research plan, reference list and synopsis (Table 1). Each panel member reviewed and scored either six or twelve proposals (May–August 2013). Proposals were assigned to reviewers based on their expertise in Basic Science or Public Health and an absence of conflicts of interest.

Simplified scoring

The Official panels rank proposals using a weighted calculation using three criteria-based integer scores (from a low 1 to a high 7) for scientific quality, significance and innovation, and track record. The scores are used to determine an overall ranking and the highest ranked proposals are awarded funding within the budget limitations. Despite the 7-point scale, proposals typically receive one of three category scores. For example, in 2013 almost all proposals scored a 4, 5 or 6 (94.8%); the highest category of 7 (0.1%) and lowest categories of 3 (4.9%), 2 (0.2%) or 1 (nil) are rarely or never used.

We used a simplified scoring process where panel members rated each proposal as: definitely fund, possibly fund, or definitely do not fund. This simplified score is designed to help peer reviewers focus on the actual decision, rather than a more complex criteria-based scoring system which is a step removed from the final decision and has been described as oblique by some reviewers.²² We awarded funding in our Simplified panel if 50% or more of the 7-person panel recommended 'definitely fund', and for our Journal panel if both external reviewers recommended 'definitely fund'.

Statistical analysis

Cross-tabulations were used to examine the agreement between the Simplified and Official panels for the dichotomous funding outcomes (yes or no). The main outcome is the percentage agreement in funding, for which confidence intervals were generated using a bootstrap algorithm. We use agreement because our aim was to find processes that were as good as the official process but with lower costs. Our previous survey of Australian researchers found the median threshold (from 145 responses) of acceptable agreement for two hypothetical review panels assessing the same proposals was 75%, therefore this level is a meaningful threshold for interpreting acceptable agreement.³ We apply this threshold to the

percentage agreement without adjusting for chance agreement, as this is the agreement that would be observed in practice.

Data on time spent and travel were used to estimate the costs of peer review. Members of the Simplified panels reported their time spent reviewing the 36 proposals in preparation for the face-to-face meeting, and their time spent preparing a spokesperson report for each allocated proposal. Travel and accommodation costs to convene the face-to-face meetings were also included. The Journal panel reported on their time spent reviewing each proposal.

The R package (version 3.0.2) was used for all analyses.

RESULTS

Official and simplified panel members

Most panel members had senior academic appointments of Professor or Associate Professor, and had prior experience of being a NHMRC peer reviewer (Table 2). Compared with the official panels our panels had more women and more members from Group of Eight universities, but were similar in terms of academic level.

Table 2 Summary statistics on the characteristics of 14 members of the simplified panel, 16 members of the journal panel and 2013 NHMRC panel members (where available).

Characteristic	Simplified panel (n=14)	Journal panel (n=16)	NHMRC (n=922)
Female, n (%)	8 (57%)	6 (38%)	215 (36%)*
Professor or Associate Professor, n (%)	11 (79%)	11 (69%)	687 (75%)
Previous experience with NHMRC panel, n (%)	9 (64%)	10 (63%)	NA

Previous external reviewer for NHMRC, n (%)	13 (93%)	14 (88%)	NA
Group of Eight university, n (%)	8 (57%)	9 (56%)	30 (30%)**
Number of previously submitted NHMRC Project Grant applications, median (IQR)	10 (3–18)	NA	NA

* For Project Grant panel members only, whereas other results include other NHMRC panels

(e.g., partnership projects)

** From a random sample of 100 out of 922 members as this information was not routinely available

Agreement between the simplified and official processes

The mean agreement between the Simplified and Official panels (72%, 95% CI 61–82%), and the Journal and Official panels (74%, 62–83%), was just below the acceptable threshold of 75% (Table 3). The agreement about which proposals to fund was lower than the agreement about which proposals not to fund. This is partly because many more proposals were not funded than funded. The agreement between the simplified and official processes was slightly lower for Basic Science than for Public Health. The mean agreement between the two simplified panels (79%, 68–89%) was above the 75% threshold (Table 4).

Table 3 Comparison of proposals funded by the Simplified or Journal panels, with the official funding agency (National Health and Medical Research Council of Australia, NHMRC)

Funded by simplified peer review process						
Simplified panels	Basic Science		Public Health		Total	
	n=36		n=36		n=72	
	Yes	No	Yes	No	Yes	No
Funded by NHMRC	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)

Yes	4 (11)	7 (19)	2 (6)	2 (6)	6 (8)	9 (13)
No	4 (11)	21 (58)	7 (19)	25 (69)	11 (15)	46 (64)
	% (95% CI)		% (95% CI)		% (95% CI)	
Agreement	69 (56, 83)		75 (61, 89)		72 (61, 82)	
Disagreement	31 (17, 44)		25 (11, 39)		28 (18, 39)	
Journal panels	Basic Science		Public Health		Total	
	n=36		n=36		n=72	
	Yes	No	Yes	No	Yes	No
Funded by NHMRC	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Yes	1 (3)	10 (28)	0 (0)	4 (11)	1 (1)	14 (19)
No	3 (8)	22 (61)	2 (6)	30 (83)	5 (7)	52 (72)
	% (95% CI)		% (95% CI)		% (95% CI)	
Agreement	64 (47, 78)		83 (69, 94)		74 (62, 83)	
Disagreement	36 (22, 53)		17 (6, 31)		26 (17, 38)	

Table 4 Comparison of proposals funded by the Simplified panels and Journal panels

Funded by simplified panel						
	Basic Science		Public Health		Total	
	n=36		n=36		n=72	
	Yes	No	Yes	No	Yes	No
Funded by Journal	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Yes	2 (6)	2 (6)	2 (6)	0 (0)	4 (6)	2 (3)
No	6 (17)	26 (72)	7 (19)	27 (75)	13 (18)	53 (74)
	% (95% CI)		% (95% CI)		% (95% CI)	
Agreement	78 (64, 92)		81 (67, 92)		79 (68, 89)	
Disagreement	22 (8, 36)		19 (8, 33)		21 (11, 31)	

Time spent on simplified peer review

Twice the amount of time was spent reviewing a Basic Science proposal compared with a Public Health proposal (Table 5), possibly due to the technical nature of Basic Science proposals. Similar amounts of time were spent preparing a spokesperson report for the Simplified panel or a Journal panel review. The Simplified panel peer review cost \$A1109 per proposal, including the costs to attend at a face-to-face meeting. The peer review cost for the Journal panel dropped to \$A359 per proposal because of the smaller number of reviewers and absence of travel and accommodation costs. The majority of these costs come from the reviewers' time.

We previously estimated the costs of peer review for the 2009 official funding round to be \$A4.44 million for 2,983 proposals.²³ Based on these figures the cost per proposal in 2013 would be \$A1649 (adjusted for inflation). Hence the estimated cost of the official peer review process in 2013 for 3,821 proposals is \$A6.3 million. In comparison, the estimated cost of reviewing the same number of proposals using the Simplified panels is \$A4.2 million and the Journal panels is \$A1.4 million. This gives estimated savings of \$A2.1 to \$A4.9 million per year from using our simplified.

Table 5 Time spent on peer review and cost per proposal, by research area

Simplified panel		Cost per proposal					
		Preparation				Attendance	
		Review	Spokesperson report		Expenses	Total	
Proposals	n	Time, hr	Salary, \$	Time, hr	Salary, \$	\$	\$
Basic Science	36	4.3	434	2.2	204	548	1186
Public Health	36	3.5	390	1.2	115	525	1030

Total / Average		72	3.9	412	1.7	160	537	1109
Journal panel		Two external reviews						
Proposals	n	Time, hr	Salary, \$					
Basic Science	36	4.7	465					
Public Health	36	2.4	252					
Total / Average	72	3.6	359					

Expenses (\$) include salary, airfares, transport, accommodation, catering, honorarium.

DISCUSSION

Using shortened proposals and simplified peer review processes gave a close to adequate agreement with the official NHMRC panels. The NHMRC streamlined the application process for the 2014 round and removed many sections (Table 1). Our results indicate that this streamlining would not have greatly altered funding outcomes.

By examining the agreement of the streamlined systems with the current system we imply that the current system is a “gold standard”, but the number of peer reviewers per proposal needed to provide anything like a gold standard is in the thousands,²⁴ whereas the current system uses around 12 reviewers per proposal. Despite this, our aim was to show reasonable agreement with the current system in terms of funding, but for lower costs. In other words, we aimed to find an equally imperfect system, but with lower costs. We chose funding as the key (binary) outcome, rather than continuous outcomes such as scores, because funding is what matters most to applicants.

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3 A key strength of this study was the rare opportunity to convene experimental peer review
4 panels to assess actual proposals in parallel with the official process. Our relatively small
5 sample size of 72 proposals is comparable to a Finnish study of 65 proposals using two
6 panels.²⁰ Large sample sizes are difficult in this field because of the high costs of using face-
7 to-face meetings.
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12 The success rate for our sample of Basic Science proposals was higher than the official
13 success rate (31% vs 19%), and for Public Health the success rate was lower (11% vs 13%),
14 indicating some difference in the calibre of the study proposals with the wider population of
15 proposals.²⁵ The much higher success rate in Basic Science may be because the researchers
16 who were willing to provide their proposals for experimental peer review were more senior.
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21 We expect there to be more consensus in funding decisions for the best and worst
22 proposals.^{22, 26} A related study of journal peer review found the agreement for paper
23 publication was twice as likely for the *rejection* of an article compared with acceptance,²⁷ and
24 a related study of funding peer review in Finland found a higher reliability for identifying
25 average and poor proposals than good proposals.²⁰ Our results also show a stronger
26 agreement about what proposals not to fund compared with what proposals should be funded.
27 This could be because reviewers are consistently able to find proposals that have significant
28 flaws, but find it harder to separate high quality proposals.
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33 The agreement found in this study is comparable to the small number of other studies of
34 observed agreement (65–76%) when comparing similar or identical peer review systems.¹⁸⁻²⁰
35 Most researchers understand that peer review processes are unlikely to ever achieve perfect
36 agreement, as even identical peer review processes will give different funding outcomes
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because of the inherent variability due to subjectivity in peer review.^{7, 23} Our comparisons between panels included many sources of variability, including measurement error and variability due to differences in panel members and their preferences, and these sources of variability will always be part of peer-review.

Simplified application processes should save time for researchers as applicants and peer reviewers. In this study we only examined the costs saved by peer review which were between \$A2.1 to \$A4.9 million per year thanks to reduced travel costs and reviewer time. Our previous research estimated the majority of costs for the NHMRC Project Grant scheme were for applicants (85%), with the remainder by peer reviewers (9%) and administrators (5%).²³ The high applicant costs are due to an average application time of 34 working days. Simplified processes should take less application time and hence save even more costs, although surprisingly our recent research found that time spent on applications increased after the application process was simplified.¹¹

The Journal panel did not include track record but still had reasonable agreement with the official process. This could be because researchers with strong track records are more experienced at writing proposals. An application without track record would save potentially large amounts of application time because each researcher needs to write a two-page CV and keep their publication information up-to-date in the online system.

One potential disadvantage of a journal panel is that by using fewer reviewers there would be more proposals with the same score, and this would create a problem if the funding line straddled a set of tied proposals. In this case either a third reviewer could be sought or the winners could be selected at random on the basis that they are equally good.

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5 The journal panels had a low rate of funding, awarding just 6 out of 72 (8%). This could be
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7 because both reviewers needed to recommend funding. It could also be because independent
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9 reviewers give harsher scores when working alone compared with working in a group.
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11 However two studies that examined the change in preliminary scores after panel discussion
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13 found that scores were more likely to get worse than better.^{20, 28}
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19 Everyone would gain from simplified peer review systems that are cheaper: the funding
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21 agencies, institutions, and the researchers as applicants and peer reviewers. Funding agencies
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23 around the world face the challenge of a static or diminishing pool of funds. A way to
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25 increase the amount of money allocated to research is to improve the efficiency of the process
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27 and return the cost savings to the funding pool. Our simplified peer review process can save
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29 costs and researchers' time, and provide estimated savings of \$A2.1 to \$A4.9 million that
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31 could be used to fund additional proposals or spend on actual research. The NHMRC has
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33 started a Streamlining Application and Assessment Project,²⁹ and the most recent federal
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35 budget assigned \$9.9 million over five years from 2014–15 to “develop a nationally
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37 consistent approach to the way clinical research trials are overseen and conducted and to
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39 streamline and simplify National Health and Medical Research Council grant application and
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41 assessment processes”.³⁰ Our results indicate that a very low cost journal-style system with
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43 short applications that do not use track record could potentially replace the current more
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45 complex and costly system. Funding agencies may want to see more evidence before making
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47 such a large change to their systems, and they could do this by running parallel panels that
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49 use a simpler system and comparing the outcomes with the standard system. This requires
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51 some additional costs to set up the parallel panels, but these one-off costs would be offset by
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the savings in future funding rounds if the comparison showed that the simpler system performed well.

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Competing Interests None declared.

Contributors DLH, NG, PC and AGB designed the study. DLH led the data collection with input from NG and AGB. AGB led the data analysis with input from DLH, NG and PC. DLH, NG, PC and AGB helped interpret the results. DLH wrote the first draft of the manuscript with input from NG, PC and AGB. AGB is the study chief investigator and guarantor.

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Ethics approval Queensland University of Technology Ethics Committee.

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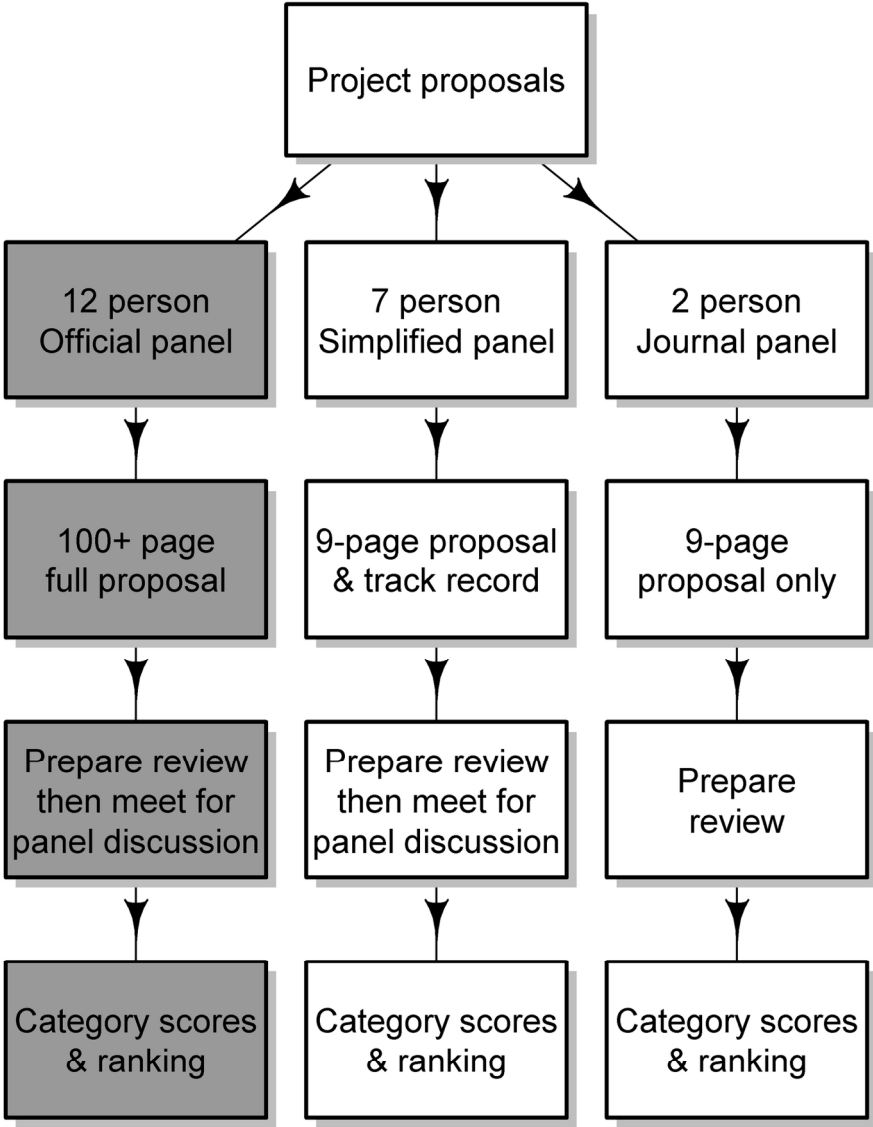
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Study design for shortened proposals and simplified peer review processes. The official funding process (shown in grey) was independent of this study.
152x182mm (300 x 300 DPI)



CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	Not applicable
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	2
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	4-5
	2b	Specific objectives or hypotheses	5
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	5-6, 8-9, Figure 1
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	No changes
Participants	4a	Eligibility criteria for participants	6, 8, 9
	4b	Settings and locations where the data were collected	6, 8, 9
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	6, 8, 9
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	9, 10
	6b	Any changes to trial outcomes after the trial commenced, with reasons	No changes
Sample size	7a	How sample size was determined	6, 15
	7b	When applicable, explanation of any interim analyses and stopping guidelines	Not applicable
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	Not applicable
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Not random
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Not applicable
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Not applicable

1				
2	Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	Not applicable
3				
4		11b	If relevant, description of the similarity of interventions	Not relevant
5	Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	10
6		12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	10
7				
8				
9	Results			
10	Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	Figure 1
11		13b	For each group, losses and exclusions after randomisation, together with reasons	Not applicable
12	Recruitment	14a	Dates defining the periods of recruitment and follow-up	6
13		14b	Why the trial ended or was stopped	Not applicable
14	Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Table 2
15	Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	Tables 3 & 4
16				
17	Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Tables 3 & 4
18		17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	Absolute only - Tables 3 & 4
19				
20	Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	Table 5
21	Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	Not applicable
22				
23	Discussion			
24	Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	14-15
25	Generalisability	21	Generalisability (external validity, applicability) of the trial findings	6, 15
26	Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	14-16
27				
28	Other information			
29	Registration	23	Registration number and name of trial registry	Not applicable
30	Protocol	24	Where the full trial protocol can be accessed, if available	Not applicable
31	Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	16
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