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Directing research funds to the right research projects: a review of criteria used by research organisations in Australia in prioritising health research projects for funding

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-026207
Article Type:	Research
Date Submitted by the Author:	22-Aug-2018
Complete List of Authors:	Tuffaha, Haitham; Griffith University Menzies Health Institute Queensland; Griffith University Centre for Applied Health Economics El_Saifi, Najwan; Griffith University Menzies Health Institute Queensland; Griffith University Centre for Applied Health Economics Chambers, Suzanne; Griffith University Menzies Health Institute Queensland Scuffham, Paul; Griffith University, Menzies Health Institute Queensland; Griffith University Centre for Applied Health Economics
Keywords:	research prioritisation, selection criteria, value for money

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3 1 **Directing research funds to the right research projects: a review of criteria used by research**
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5 2 **organisations in Australia in prioritising health research projects for funding**
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35 18 **Key words: research prioritisation, selection criteria, value for money**
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38 19 **Word count: 2500**
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3 21 **Directing research funds to the right research projects: a review of criteria used by research**
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5 22 **organisations in Australia in prioritising health research projects for funding**
6

7 23 **Abstract**
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10 24 **Objectives**
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13 25 Healthcare budgets are limited, and therefore, research funds should be wisely allocated to
14
15 26 ensure high quality, useful and cost-effective research. We aimed to critically review the
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17 27 criteria considered by major Australian organisations in prioritising and selecting health
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19 28 research projects for funding.
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22 29 **Methods**
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25 30 We reviewed all grant schemes listed on the Australian Competitive Grants Register that
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27 31 were health-related, active in 2017 and with publicly available selection criteria on the
28
29 32 funders' websites. Data extracted included scheme name, funding organisation, selection
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31 33 criteria and the relative weight assigned to each criterion. Selection criteria were grouped into
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33 34 five representative domains: relevance, appropriateness, significance, feasibility (including
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35 35 team quality) and cost-effectiveness (i.e., value for money).
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38 36 **Results**
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41 37 Thirty-six schemes were included from 158 identified. One half of the schemes were under
42
43 38 the National Health and Medical Research Council. The most commonly used criteria were
44
45 39 research team quality and capability (94%), research plan clarity (94%), scientific quality
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47 40 (92%) and research impact (92%). Criteria considered less commonly were existing
48
49 41 knowledge (22%), fostering collaboration (22%), research environment (19%), value for
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51 42 money (14%), disease burden (8%) and ethical/moral considerations (3%). In terms of
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53 43 representative domains, relevance was considered in 72% of the schemes, appropriateness in
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3 44 92%, significance in 94%, feasibility in 100%, and cost-effectiveness in 17%. The relative
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5 45 weights for the selection criteria varied across schemes with 5-30% for relevance, 20-60% for
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7 46 each appropriateness and significance, 20-75% for feasibility and 15-33% for cost-
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9 47 effectiveness.

11 48 **Conclusions**

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15 49 In selecting research projects for funding, Australian research organisations focus largely on
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17 50 research appropriateness, significance and feasibility; however, value for money is most often
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19 51 overlooked. Research funding decisions should include an assessment of value for money in
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21 52 order to maximise return on research investment.

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25 54 **Strengths and limitations**

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29 55 1. The first critical review of research project selection criteria from a funder perspective
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31 56 in Australia.
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33 57 2. A comprehensive review of available funding schemes, selection criteria and scoring
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35 58 weights to prioritise research proposals.
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37 59 3. The recommendations provided will help research organisation streamline funding to
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39 60 worthy projects to maximise return on research investment.
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41 61 4. The review takes an Australian perspective, but the findings and recommendations
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43 62 maybe applicable to other jurisdictions

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64 INTRODUCTION

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66 Research is vital to generate evidence to guide medical decision making and improve
67 health. Therefore, the Australian Government and various research organisations allocate
68 considerable resources to fund clinical trials and other health research. The total expenditure
69 on health research in Australia was around \$5.4 billion dollar in 2014.[1] Recently, the
70 Australian Government has announced the establishment of the \$20 billion Medical Research
71 Future Fund.[2] There has been an emerging interest in Australia and internationally to
72 maximise value and reduce waste in healthcare research.[3-5] Although research value should
73 be ensured throughout the continuum (i.e., from research question development to
74 implementation of the findings), directing research funds to the right research projects in the
75 first place is key to optimise health and economic benefits from healthcare research.

76 Most research projects in Australia are investigator initiated and researchers must
77 seek financial support for their proposals through research funding organisations (e.g., the
78 National Health and Medical Research Council (NHMRC)). However, the overall funds
79 available for research are limited compared to the number of submissions and decisions have
80 to be made about the best way to distribute research funds. Thus, funding organisations need
81 to have a transparent and systematic way to evaluate and prioritise research projects for
82 funding.[5-7] This is often done based on the assessments of the merits of the submitted
83 proposals according to the judgments of experts sitting on funding panels.[6, 8] In this
84 process, submitted proposals are assessed and scored against predefined criteria with each
85 criterion, or group of criteria, being assigned a weight reflecting its relative importance. Such
86 practice corroborates with the recommendations of many international initiatives for setting
87 research priorities where the use of explicit and comprehensive criteria is encouraged to
88 ensure that important considerations are not overlooked during the selection process.[7, 9-12]

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3 89 In general, these criteria may include burden of the disease, equity, scientific rigor, research
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5 90 team capabilities, innovation and impact of research results; however, the choice of criteria
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7 91 and the scoring system may differ, depending on the needs of stakeholders involved in this
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9 92 exercise.[7, 9-12]

11 93 Whilst health research funding decisions in Australia rely heavily on the ability of
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13 94 research proposals to meet selection criteria, it is unknown what criteria are more commonly
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15 95 used by research funders, how these criteria and their weights vary across funding
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17 96 organisations, and whether these criteria are comprehensive enough to capture all important
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19 97 considerations to ensure high quality and cost-effective research. This knowledge is
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21 98 important to assess the current approach of selecting and funding research projects, and to
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23 99 guide future efforts to optimise health research funding mechanisms in the country.
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26 100 Therefore, the aim of this paper was to critically review the criteria considered by major
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28 101 Australian research organisations in their selection of health research projects for funding.
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32 103 **METHODS**

34 104 We reviewed all research funding schemes listed on the Australian Competitive
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36 105 Grants Register (ACGR), which provides a comprehensive list of funding schemes that have
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38 106 been approved by the Australian Government as being competitive research grants.[13] The
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40 107 identified schemes were included if they were health related, active in 2017, and had clear
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42 108 selection criteria which were publically available on the funders' websites. Health research
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44 109 refers to research with human health or medical purpose, including research on the aetiology,
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46 110 diagnosis or management of disease, mental condition or behaviour in human. To focus on
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48 111 schemes for funding research projects and programs, research schemes dedicated solely to
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50 112 training, capacity building, equipment or infrastructure were excluded. These include
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52 113 fellowships, awards and scholarships as well as research and training centres.
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3 114 Data extracted included scheme name, year first implemented, funding organisation,
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5 115 selection criteria and the relative weight assigned to each criterion. Selection criteria were
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7 116 grouped into five representative domains: relevance (i.e., why should we do it?, including the
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9 117 burden of disease and level of existing knowledge), appropriateness (i.e., should we do it?,
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11 118 including scientific rigour and suitability to answer the research question), significance of
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13 119 research outcomes (i.e., what will we get out of it?, including impact and innovation),
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15 120 feasibility (i.e., can we do it?, including team quality and research environment), and cost-
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17 121 effectiveness (i.e., is the proposed research potentially good value for money?).[7, 10] The
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19 122 domains were selected based on the lists of criteria and categories suggested in two
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21 123 comprehensive tools for research prioritisation, the Essential National Health Research
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23 124 Approach (relevance, appropriateness, feasibility and significance) and the Checklist for
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25 125 Health Research Priority Setting (benefits, feasibility, and cost-effectiveness).[7, 10]
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27 126 Disagreements related to assigning criteria to their representative domains were either
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29 127 resolved by discussion or the involvement of a third reviewer who was provided with the full
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31 128 assessment or selection criteria for consensus decision-making. A domain was counted under
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33 129 a given scheme if at least one criterion within that domain is reported in the selection criteria
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35 130 of that scheme. Table 1 provides a description of the representative domains.

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41 131 **Table 1: Description of domains and relevant criteria**[7, 10]

Domain	Definition
Relevance	The key question for this domain is “why should we do it?” The proposed research is pertinent to the health problems of interest. It takes into consideration burden of disease, equity, alignment with national/organisational objectives and the level of existing knowledge in relation to the intervention.
Appropriateness	The key question for this domain is “should we do it?” The proposed research is well suited to answer the decision problem. It takes into consideration ethical, moral and legal acceptability, and scientific rigor.
Significance	The key question for this domain is “what will we get out of it?” It represents the benefit of implementing/translating the research results. It takes into consideration the impact on health, innovation, and ability to foster capacity building and collaboration.
Feasibility	The key question for this domain is “can we do it?” The focus is on the chances of research success. It considers team quality (track record) and capability, research environment, and the research plan.
Cost-effectiveness	The key question for this domain is “is the research cost-effective?” This theme focuses on the

	value for money of the research proposal. It considers the costs and expected benefits of conducting research.
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133 **RESULTS**

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135 Thirty-six schemes met our inclusion criteria from 158 schemes listed on the 2017

136 ACGR. Figure 1 summarises the review process.

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Fig1: Flowchart of the review

138 One half of the schemes were under the NHMRC. Five schemes (14%) were

139 specifically for research in cancer, four (11%) for dementia, four (11%) for mental health,

140 and three (8%) for diabetes. Table 2 summarises the selection criteria for the included

141 schemes with their definitions as reported on the websites of their relevant funding

142 organisations. A summary of the selection criteria considered by each scheme is presented in

143 Table

3.

Table 2: Summary of selection criteria and scoring weights of the included schemes

Agency	Scheme name	Year listed	Assessment criteria	Score
NHMRC	Partnership Projects[14]	2017	Track record of investigators relative to opportunity	25%
			Scientific quality of the proposal and methodology	25%
			Relevance and likelihood to influence health and research policy and practice	25%
			Strength of partnership	25%
NHMRC	Program Grants[15]	2017	Team research achievements (publications, grants, awards)	60%
			Research strategy (quality, addresses important issues, impact, innovation, achievable)	20%
			Collaborative gain (team integration, training and mentoring)	20%
NHMRC	Project Grants[16]	2017	Scientific quality (research plan clarity, appropriateness and feasibility)	50%
			Significance of outcomes and/or innovation of the concept (advance knowledge, outcomes, translation, publications)	25%
			Team quality and capability relative to opportunity (expertise, reputation, achievements)	25%
NHMRC	Global Alliance for Chronic Diseases (GACD) ^{a[17]}	2014	Relevance and quality of project (scheme objectives, appropriate and feasible methods, innovative, ethical)	25%
			Quality of team (high quality track-record, capacity building, public engagement)	25%
			Implementation plans/feasibility (challenges identified, inequality gaps considered)	25%
			Potential impact (outcome utilization, economic impact assessed)	25%
NHMRC	NHMRC's Targeted Call for Research Program ^{b[18-22]}	2013	Scientific quality and likelihood to answer the research question(s) (relevant, feasible consumers engaged)	40-60%
			Whether the team has all the necessary skills and expertise to achieve the expected outcomes	20-50%
			Significance of the project and expected outcomes	0-40%
NHMRC	Dementia Research Team Grants[23]	2014	Generate new knowledge that leads to improved health outcomes (clarity, quality of methods, feasibility, innovation)	25%
			Record of research and translation achievement - relative to opportunity (contribution to the field of research, research outputs)	25%
			Facilitate collaboration (collaboration, integration and cohesiveness of the team)	20%
			Promote effective transfer of outcomes into health policy and/or practice (quality of the plan, involvement of end user)	20%
			Develop the health and medical research workforce	10%
NHMRC	Development Grants[24]	2017	Scientific merit of the proposal (quality of the scientific research)	40%
			Record of commercial achievements (relative to opportunity)	20%
			Commercial potential (high impact, innovation, relevant to schemes objectives)	40%
NHMRC	National Institute for Dementia Research Grants[25]	2015	Relevance to the aims of the round and significance of outcomes (relevant to scheme objectives, potential to improve outcomes)	30%
			Project design, methods and analyses (feasible and suitable environment, consumers and clinicians engaged)	30%
			Budget justification and value for money (proposal demonstrates that it is cost effective)	15%

			Team quality and capability relevant to the project (team capacity, ability, and expertise)	25%
NHMRC	NHMRC/NSFC, Prediction and Treatment of Type 2 Diabetes in China and Australia[26]	2015	Scientific quality of the project including feasibility (fits within aims of the scheme, feasible, appropriate methods)	25%
			Significance of the expected outcomes (impact on health, advance knowledge)	25%
			Track record of the team (team capability, track-record)	25%
			Added value of international collaboration (collaboration, transfer of knowledge)	25%
NHMRC	Northern Australia Tropical Disease Collaborative Research Program[27]	2016	Generate new knowledge that leads to improved health outcomes	20%
			Promote effective transfer of research outcomes into health policy and/or practice	20%
			Develop the health and medical research workforce	20%
			Facilitate collaboration	20%
			Record of research and translation achievements - relative to opportunity	20%
NHMRC	Translational Research Projects[28]	2017	Significant relevance to the health system	NA
			Inform evidence-based improvement to health care	NA
			Outcomes for patients, and/or efficiency in healthcare and/or cost savings	NA
			Includes a plan for dissemination of results within the healthcare sector	NA
			Represents value for money	NA
			Excellent level research team	NA
NHMRC	Boosting Dementia Research Grants[29]	2017	Relevance to the aims of the round and significance of expected outcomes	30%
			Project design, methods and analyses (clear, coherent, involvement with consumers, innovation, feasible, translation/impact)	30%
			Project justification and value for money (demonstrate value for money)	15%
			Team quality and capability relevant to the project (team strength, reputation, contributions)	25%
Department of Foreign Affairs and Trade	Tropical Disease Research Regional Collaboration Initiative[30]	2017	Activity effectiveness and value for money (strengthen research capability and collaboration, clear objectives, budget justified)	50%
			Organisational effectiveness (record of strengthening research collaboration)	50%
Cancer Australia	Priority-Driven Collaborative Cancer Scheme[31]	2017	Team quality and capability relevant to the application	40%
			Outcomes and impact of current proposal	25%
			Translation of research	10%
			Collaborations	15%
			Consumer involvement	10%
Cancer Australia	Support for Cancer Clinical Trials Program Grant[32]	2013	National multi-disciplinary membership, governance structure, data and quality, capacity building, collaboration, translation	33.3%
			How the funding will be utilized	33.3%
			Budget and value for money	33.3%
Alzheimer's	Dementia Grants	2017	Scientific merit and quality (relevance, clarity and suitability of methods and plan)	50%

Australia Dementia Research Foundation	Program[33]		Track record and independence of the applicant	30%
			Innovation/originality	20%
			The Scientific Panel will also consider the feasibility of proposed projects	
Australian and New Zealand College of Anaesthetists	Project Grants[34]	2017	Scientific merit, design/methods, track record, originality, feasibility and international competitiveness	NA
Australian Rotary Health	Mental Health Research Grants[35]	2017	Scientific excellence of the project	NA
			Innovation of the project	NA
			Track record of the applicant	NA
			Feasibility, including relevant partnerships	NA
Bupa Foundation (Australia) Limited	Bupa Health Foundation[36]	2017	Practical benefits to the mental health of the community	NA
			Direct impact on health outcomes	NA
			Timing of delivery of results	NA
			Justification of funding	NA
Cure for MND Foundation	Translational Research Grants[37]	2017	Study/program design	NA
			Reputation of organisation	NA
			Research strategy and feasibility	50%
			Impact and transition potential	25%
Diabetes Australia Research Trust	General Grants[38]	2017	Personnel and budget	25%
			Research methods and quality	40%
Healthway (Western Australian Health Promotion Foundation)	Health Promotion Intervention Research Grants[39]	2017	Potential research outcomes	60%
			Ability to directly improve health and community outcomes in priority health areas	NA
			Contribution of the research to best practice in health promotion	NA
			The quality of the translation plan	NA
			End-user partnerships and collaboration	NA
			Soundness of rationale and methodology	NA
HCF Research Foundation	Health Services Research Grants[40]	2017	Track record and capability of research team	NA
			Appropriateness of the budget, and overall value for money	NA
			Scientific merit (design, methodology, feasibility, budget)	40%
Motor Neurone Disease Research Institute of Australia	Grants-in-aid[41]	2017	Relevance to HCF objectives (translation, response to knowledge gaps, improve health)	40%
			General (repeat other studies/ongoing studies, burden of disease)	20%
			Track record of the applicant	NA
Multiple Sclerosis Research Australia	Research Grants[42]	2017	Strength of the research plan	NA
			Relevance to Motor Neurone Disease	NA
Multiple Sclerosis Research Australia	Research Grants[42]	2017	Relevance to Multiple Sclerosis	NA
			Significance (value and novelty)	NA

			Feasibility of methods	NA
			Track record of applicants	NA
National Breast Cancer Foundation	Innovator Grant [43]	2017	Novelty of the project	50%
			Track record of applicant	20%
			Quality and feasibility	20%
			Relevance to National Breast Cancer Foundation research priorities	10%
National Breast Cancer Foundation	Accelerator Research Grant[44]	2016	Translational potential and impact on breast cancer outcomes	50%
			Track record of applicant team	20%
			Scientific quality and feasibility	20%
			Relevance to National Breast Cancer Foundation research priorities	10%
National Heart Foundation	Vanguard Grant[45]	2017	Track record of applicants	NA
			How well the application addresses the purpose of the award	NA
			Quality of the research proposal	NA
			Feasibility of the research proposal	NA
			Potential to produce tangible outcomes	NA
Prostate Cancer Foundation of Australia	New Concept Grant[46]	2017	Track record of investigator team	NA
			Scientific and technical merit of the research question, feasibility, design and methodology.	NA
			Innovation	NA
			Potential impact on prostate cancer	NA
			Research environment (suitability, expertise and collaboration)	NA
The Movember Group and Beyondblue	Australian Mental Health Initiative[47]	2013	Alignment and fit with Movember’s strategic goals	NA
			Significance/innovation of the project (advance management, address significant areas)	NA
			Project proposal (clarity, achievability, collaboration, consultation with stakeholders, plan, knowledge translation)	NA
			The project team (proven expertise, capability, record)	NA

NHMRC: National Health and Medical Research Council, NSFC: National Natural Science Foundation of China, MND: Motor Neurone Disease, HCF: The Hospitals Contribution Fund of Australia.

^a Global Alliance for Chronic Disease Grants include: Request for Applications on Type 2 Diabetes in Low and Middle Income Countries, Request for Applications on the Prevention and Management of Chronic Lung Disease in Middle and Low Income Countries and Indigenous Communities in Australia and Canada, Request for Prevention and Management of Mental Disorders in Low and Middle Income Countries and Indigenous Communities in High Income Countries.

^b Targeted calls include: Targeted Call for Research into Wind Farms and Human Health, Targeted Call for Research into Preparing Australia for the Genomics Revolution in Health Care, Targeted Call for Research into Engaging and Retaining Young Adults in Interventions to Improve Eating Behaviours and Health Outcomes, Targeted Call for Research into Fetal Alcohol Spectrum Disorder among Aboriginal and Torres Strait Islander Peoples, Targeted Call for Research into Mental Health : Suicide Prevention in Aboriginal and Torres Strait Islander Peoples

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Table 3: Selection criteria domains for schemes and funding organisations

Organisation and Scheme Name	Relevance			Appropriateness			Significance			Feasibility				Cost-effectiveness		
	Burden	National/Organisational Priorities	Existing Knowledge	Scientific Quality	Answerability	Ethical/Moral	Innovation Impact	Translation/Implementation	Foster Capacity/Collaboration	Research Team Quality	Environment	Stakeholders Involved	Research Plan	Budget Justification	Value for Money	
NHMRC																
Boosting Dementia Research Grants	-	✓	-	✓	-	-	✓	✓	✓	-	✓	-	✓	✓	✓	✓
Dementia Research Team Grants	-	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	-	-
Development Grants	✓	✓	-	✓	-	-	✓	✓	✓	-	✓	✓	-	✓	-	-
Global Alliance for Chronic Diseases- Chronic Lung Disease	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-	✓	✓	-	-
Global Alliance for Chronic Diseases- Mental Disorders	-	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	-	-
Global Alliance for Chronic Diseases-Type 2 Diabetes Countries	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-	✓	✓	-	-
National Institute for Dementia Research Grants	-	✓	-	✓	✓	-	✓	✓	✓	-	✓	✓	✓	✓	✓	✓
NHMRC/NSFC - Prediction and Treatment of Type 2 Diabetes	-	✓	-	✓	✓	-	-	✓	✓	✓	✓	✓	-	✓	-	-
Northern Australia Tropical Disease Collaborative Research Programme	-	-	-	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	-	-
Partnership Projects	-	-	-	✓	✓	-	✓	✓	✓	-	✓	-	-	✓	-	-
Program Grants	✓	-	-	✓	-	-	✓	✓	✓	✓	✓	✓	-	✓	-	-
Project Grants	-	-	-	✓	-	-	✓	✓	✓	-	✓	-	-	✓	-	-
Targeted Call - Engaging Young Adults to Improve Eating Behaviours and Health Outcomes	-	✓	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-
Targeted Call – Mental Health : Suicide Prevention in Aboriginal and Torres Strait Islander Youth	-	-	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-
Targeted Call- Fetal Alcohol Spectrum Disorder among Aboriginal and Torres Strait Islander Peoples	-	-	✓	✓	✓	-	-	✓	-	-	✓	-	✓	✓	-	-
Targeted Call- Preparing Australia for the Genomics Revolution	-	✓	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-

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Targeted Call-Wind Farms and Human Health	-	✓	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-
Translational Research Projects for Improved Health Care	-	✓	-	-	-	-	-	✓	-	-	✓	-	-	✓	-	✓
Cancer Australia																
Priority-Driven Collaborative Cancer Scheme	-	✓	-	-	-	-	-	✓	✓	✓	✓	-	✓	-	-	-
Support for Cancer Clinical Trials Program-Existing National Cooperative Oncology Groups	-	-	-	✓	-	-	-	-	✓	✓	-	-	-	✓	✓	✓
National Breast Cancer Foundation																
Accelerator Research Grant	-	✓	-	✓	-	-	-	✓	✓	-	✓	-	-	✓	-	-
Innovator Grant	-	✓	-	✓	-	-	-	✓	✓	-	-	✓	-	-	✓	-
Department of Foreign Affairs and Trade																
Tropical Disease Research Regional Collaboration Initiative	-	✓	-	✓	✓	-	-	✓	✓	✓	✓	-	-	✓	✓	✓
Alzheimer’s Australia Dementia Research Foundation																
Dementia Grants Program	-	-	-	✓	✓	-	-	✓	✓	-	-	✓	-	-	✓	-
Australian and New Zealand College of Anaesthetists																
ANZCA Research Grants Program	-	-	-	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
Australian Rotary Health																
Mental Health Research Grants	-	-	-	✓	-	-	-	✓	✓	-	-	✓	-	-	✓	-
Bupa Foundation																
Bupa Health Foundation	-	-	-	-	-	-	-	✓	-	-	✓	-	-	✓	-	-
Cure for MND Foundation																
Translational Research Grants	-	-	-	✓	-	-	-	✓	✓	-	✓	✓	-	✓	-	-
Diabetes Australia Research Trust																
General Grants	-	-	✓	✓	-	-	-	✓	✓	✓	-	✓	-	-	✓	-
Healthway (Western Australian Health Promotion Foundation)																
Health Promotion Intervention Research Grants	-	✓	✓	✓	-	-	-	✓	✓	✓	✓	-	✓	✓	✓	✓
HCF Research Foundation																
Health Services Research Grants	✓	✓	✓	✓	-	-	-	✓	✓	-	-	-	-	✓	-	-
Motor Neurone Disease Research Institute of Australia																
Motor Neurone Disease Research Grants	-	✓	-	✓	-	-	-	-	-	-	✓	-	-	-	-	-
Multiple Sclerosis Research Australia																
Research Grants	-	✓	-	✓	✓	-	-	✓	✓	-	-	✓	-	-	✓	-
National Heart Foundation of Australia																
Vanguard Grants	-	✓	-	✓	-	-	-	✓	✓	-	-	✓	✓	-	✓	-
Prostate Cancer Foundation of Australia																

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New Concept Grant	-	-	-	✓	-	-	✓	✓	-	-	✓	✓	-	✓	-	-
The Movember Group and beyondblue																
Australian Mental Health Initiative	-	✓	-	✓	✓	-	✓	✓	✓	-	✓	-	✓	✓	-	-

NHMRC: National Health and Medical Research Council, NSFC: National Natural Science Foundation of China, ANZCA: Australian and New Zealand College of Anaesthetists, MND: Motor Neurone Disease, HCF: The Hospitals Contribution Fund of Australia.

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1 166 The most commonly used criteria were research team quality and capability (94%),
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3 167 research plan clarity (94%), scientific quality of the proposal (92%) and research impact
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5 168 (92%). Criteria considered less commonly were existing knowledge (22%), fostering
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7 169 collaboration (22%), research environment (19%), budget justification (17%), value for
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9 170 money (14%), disease burden (8%) and ethical/moral considerations (3%). When selection
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11 171 criteria were grouped into relevant domains, all schemes considered feasibility criteria, 94%
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13 172 of the schemes considered significance, 92% considered appropriateness, 72% considered
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15 173 relevance, and only 17% considered cost-effectiveness. Only five schemes (14%) considered
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17 174 all five domains; namely, NHMRC National Institute for Dementia Research Grants,
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19 175 NHMRC Boosting Dementia Research Grants, Cancer Australia Clinical Trials Program, and
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21 176 the Department of Foreign Affairs and Trade Tropical Disease Research, and Health
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23 177 Promotion Intervention Research Grants. Figure 2 depicts the distribution of selection
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25 178 criteria.

179 **Fig2: Overall research criteria and their representative domains**

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33 180 When reported, the relative weights for the selection criteria also varied across
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35 181 schemes with 20-75% for feasibility, 20-60% for each appropriateness and significance, 15-
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37 182 33% for value for money and 5-30% for relevance criteria.

38 39 40 **DISCUSSION**

41 184 A broad range of criteria were reported in the included research funding schemes with
42
43 185 a clear focus on the quality of the research team, research plan, scientific rigor, impact, and
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45 186 translation/implementation potential. The identified schemes, within the same organisation
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47 187 and across organisations, had variable selection criteria and scoring weights. When grouped
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49 188 into representative domains, funding organisations in Australia appear to focus on research
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51 189 relevance, quality, impact, and feasibility; however, cost-effectiveness of research projects
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53 190 was largely overlooked.
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1 191 Using a predefined set of selection criteria is a transparent approach to select and
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3 192 prioritise high quality research projects for funding. The choice of criteria and their weights
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5 193 should depend on the purpose of the scheme and the organisational objectives.[7, 10] For
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7 194 instance, collaborative and partnership schemes focused on partnership strengths,
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9 195 collaborative gains, and team integration. Importantly, selection criteria and their scoring
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11 196 systems should be clear to both applicants and evaluators; therefore, it is vital to have
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13 197 clarifying statements (i.e., definitions) that can be quantitatively scored.[10] The definitions
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15 198 and the level of the details to clarify the selection criteria varied across the schemes. Notably,
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17 199 most of the schemes use sub-criteria (i.e. subsets) to define or explain a major criterion for
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19 200 which a scoring weight was assigned. For instance, criteria such as capability, time, and track
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21 201 record were collectively used to define research team quality. Moreover, it was common to
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23 202 see compound criteria such as research quality and innovation, quality and feasibility, or
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25 203 significance and innovation; however, the contribution of each sub-criterion to the major
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27 204 criterion's weight was not clear. Ideally, these sub-criteria should also have clear scores to
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29 205 guide the overall scoring of the major criterion.[10]
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34 206 The criteria used by the Australian funding organisations are in line with the general
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36 207 criteria recommended in leading international initiatives for health research prioritisation [7,
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38 208 9-11]; yet, there are important criteria that were not considered by most of the included
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40 209 schemes. Equity considerations were not explicitly mentioned as a selection criterion, and
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42 210 ethical/moral considerations were only considered in one scheme. This might be explained by
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44 211 the implicit assumptions that all submitted proposals will be approved by ethics committees
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46 212 and that equity is addressed by targeted research grants (e.g., Research in Aboriginal and
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48 213 Torres Strait Islanders). However, without clarity about where the responsibility for ethical
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50 214 and equity considerations lies there is the potential for these criteria to be overlooked.
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52 215 Furthermore, criteria to assess the extent to which a research project encourages gender
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54 216 equality in health research, such as having equal representation of genders, was absent.[48]
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1 217 Other criteria were less commonly considered despite their importance in improving research
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3 218 value. For example, the Lancet's Series on reducing waste and increasing value in medical
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5 219 research recommended engaging potential users of research in research prioritisation, and that
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7 220 proposals for additional research are justified by systematic reviews showing what is already
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9 221 known.[4, 5, 49] Notwithstanding, around 40% of the schemes in our study considered
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11 222 stakeholders' involvement (i.e., consumers and/or clinicians); however, the level of
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13 223 stakeholders' engagement and influence on funding decisions was unclear. Despite its
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15 224 importance to avoid research duplication, only 22% of the schemes considered existing
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17 225 knowledge, but none of the schemes explicitly required a systematic review of literature to
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19 226 demonstrate knowledge gaps. Our results echo the findings of a review of the extent to which
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21 227 11 international organisations adopted waste-reducing policies and processes.[3] In that
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23 228 review, only one organisation required reference to relevant systematic reviews in all funding
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25 229 applications and four funders required systematic reviews for funding clinical trials. In
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27 230 addition, public involvement was key for only three funders.[3]

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32 231 An important aspect that was also overlooked is the cost-effectiveness of the proposed
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34 232 research projects. Funding organisations may implicitly assume that selecting high quality
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36 233 and high significance projects would ensure value for money; nevertheless, value for money
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38 234 cannot be established without explicitly comparing the costs and expected benefits of
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40 235 proposals competing for funding. Interestingly, none of the schemes that required
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42 236 demonstration of value for money provided guidelines on how the cost-effectiveness of
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44 237 research projects should be performed and presented. Of note, there are rigorous analytical
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46 238 methods to prospectively quantify the expected benefits of research on improving health
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48 239 outcomes, the key analytical approaches are the 'prospective payback of research' (a similar
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50 240 approach to return on investment) and the value of information approach.[6, 50] Under the
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52 241 payback approach, the value of a research study is typically inferred from its ability to result
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54 242 in a beneficial change in clinical practice.[51] The value of information approach, on the
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2 243 other hand, considers the uncertainty in the relevant available evidence (e.g., from systematic
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4 244 reviews and meta-analyses) and the consequences of this uncertainty (e.g., implementing a
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6 245 suboptimal intervention).[52] Research benefits calculated by these approaches are scaled up
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8 246 by considering the population expected to benefit from research results over time, and these
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10 247 benefits are compared with research budget to inform cost-effectiveness.[53, 54]

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12 248 A limitation to our work is that we only reviewed active grant schemes listed on the
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14 249 ACGR; and therefore, some grant schemes may not have been included in our review;
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16 250 however, the ACGR is a comprehensive registry of major research grants by leading funding
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18 251 organisations in Australia. Additionally, it is noted that selection criteria, and schemes,
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20 252 change over time to meet political and administrative objectives. For example, the NHMRC
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22 253 is revising grant schemes as well as the selection criteria and processes for a new series of
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24 254 grants to commence funding in 2019.[55]

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28 255 In conclusion, health care research is vital to improve health; however, there is a need
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30 256 to ensure that funded research is of high quality and value for money. In selecting research
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32 257 projects for funding, Australian research funding organisations focus on research
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34 258 appropriateness, significance and feasibility; nevertheless, other important criteria should not
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36 259 be overlooked such as equity, gender equality, ethics and moral aspects and consumers'
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38 260 involvement. Importantly, research funding decisions should include an assessment of value
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40 261 for money in order to maximise return on research investment.

41 42 43 44 262 **ACKNOWLEDGMENTS**

45
46 263 The authors acknowledge Menzies Health Institute Queensland, Cancer Council
47
48 264 Queensland and the Prostate Cancer Foundation of Australia for funding this project. The
49
50 265 authors thank Professor Joanne Aitken for her contribution to this manuscript.

51 52 53 266 **COMPETING INTERESTS**

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56 267 The authors have no competing interests.

268 **FUNDING**

269 Haitham Tuffaha is supported by an Australian National Health and Medical Research
270 Council (NHMRC) fellowship (GNT1121232). This project is funded by Menzies Health
271 Institute Queensland and the Prostate Cancer Foundation of Australia.

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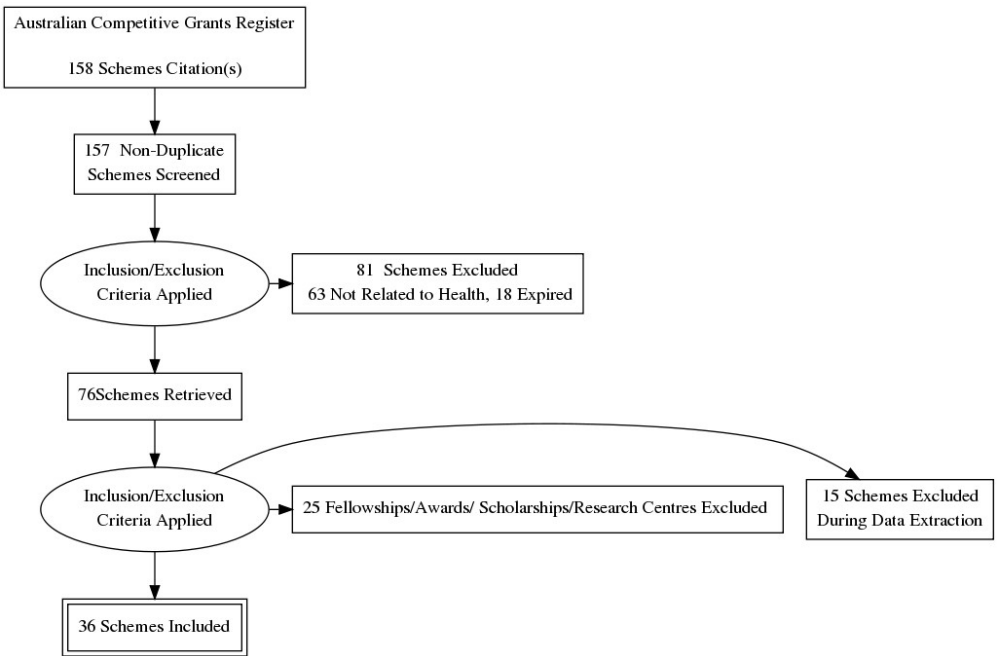
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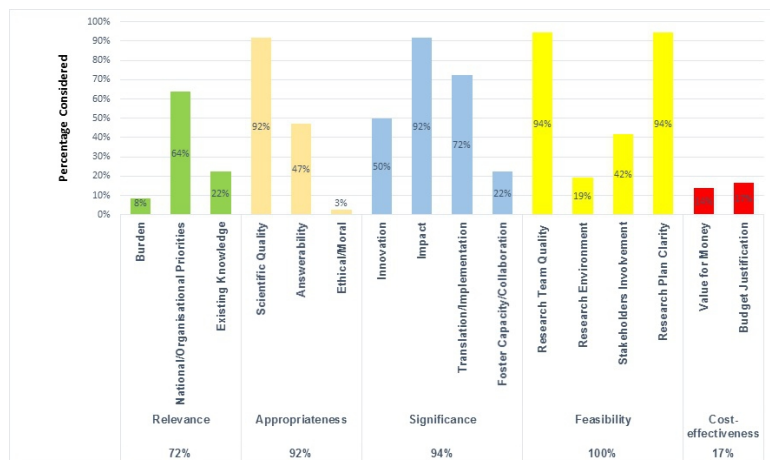
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Flowchart of the review

271x179mm (96 x 96 DPI)



Overall research criteria and their representative domains

304x171mm (96 x 96 DPI)

BMJ Open

Directing research funds to the right research projects: a review of criteria used by research organisations in Australia in prioritising health research projects for funding

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-026207.R1
Article Type:	Research
Date Submitted by the Author:	24-Oct-2018
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Primary Subject Heading:	Health policy
Secondary Subject Heading:	Health policy, Health economics
Keywords:	research prioritisation, selection criteria, value for money

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3 1 **Directing research funds to the right research projects: a review of criteria used by research**
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38 18 **Key words: research prioritisation, selection criteria, value for money**
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40
41 19 **Word count: 2500**
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3 21 **Directing research funds to the right research projects: a review of criteria used by research**
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5 22 **organisations in Australia in prioritising health research projects for funding**
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7

8 23 **Abstract**
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11 24 **Objectives**
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14 25 Healthcare budgets are limited, and therefore, research funds should be wisely allocated to
15
16 26 ensure high quality, useful and cost-effective research. We aimed to critically review the
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18 27 criteria considered by major Australian organisations in prioritising and selecting health
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20 28 research projects for funding.
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24 29 **Methods**
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26
27 30 We reviewed all grant schemes listed on the Australian Competitive Grants Register that were
28
29 31 health-related, active in 2017 and with publicly available selection criteria on the funders'
30
31 32 websites. Data extracted included scheme name, funding organisation, selection criteria and
32
33 33 the relative weight assigned to each criterion. Selection criteria were grouped into five
34
35 34 representative domains: relevance, appropriateness, significance, feasibility (including team
36
37 35 quality) and cost-effectiveness (i.e., value for money).
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41 36 **Results**
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44 37 Thirty-six schemes were included from 158 identified. One half of the schemes were under the
45
46 38 National Health and Medical Research Council. The most commonly used criteria were
47
48 39 research team quality and capability (94%), research plan clarity (94%), scientific quality
49
50 40 (92%) and research impact (92%). Criteria considered less commonly were existing knowledge
51
52 41 (22%), fostering collaboration (22%), research environment (19%), value for money (14%),
53
54 42 disease burden (8%) and ethical/moral considerations (3%). In terms of representative domains,
55
56 43 relevance was considered in 72% of the schemes, appropriateness in 92%, significance in 94%,
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3 44 feasibility in 100%, and cost-effectiveness in 17%. The relative weights for the selection
4
5 45 criteria varied across schemes with 5-30% for relevance, 20-60% for each appropriateness and
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7 46 significance, 20-75% for feasibility and 15-33% for cost-effectiveness.
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9

10 47 **Conclusions**

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13 48 In selecting research projects for funding, Australian research organisations focus largely on
14
15 49 research appropriateness, significance and feasibility; however, value for money is most often
16
17 50 overlooked. Research funding decisions should include an assessment of value for money in
18
19 51 order to maximise return on research investment.
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25 53 **Strengths and limitations**

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28
29 54 1. The first critical review of research project selection criteria from a funder perspective
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31 55 in Australia.
32
33 56 2. A comprehensive review of available funding schemes, selection criteria and scoring
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35 57 weights to prioritise research proposals.
36
37 58 3. The recommendations provided will help research organisation streamline funding to
38
39 59 worthy projects to maximise return on research investment.
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41 60 4. The review takes an Australian perspective, but the findings and recommendations
42
43 61 maybe applicable to other jurisdictions
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63 INTRODUCTION

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65 Research is vital to generate evidence to guide medical decision making and improve
66 health. Therefore, the Australian Government and various research organisations allocate
67 considerable resources to fund clinical trials and other health research. The total expenditure
68 on health research in Australia was around \$5.4 billion dollar in 2014.[1] Recently, the
69 Australian Government has announced the establishment of the \$20 billion Medical Research
70 Future Fund which aims to improve health, contribute to a sustainable health system, and
71 provide significant economic benefits.[2] There has been an emerging interest in Australia and
72 internationally to maximise value and reduce waste in healthcare research.[3-5] Although
73 research value should be ensured throughout the continuum (i.e., from research question
74 development to implementation of the findings), directing research funds to the right research
75 projects in the first place is key to optimise health and economic benefits from healthcare
76 research. This is typically achieved at two levels, 1) selecting strategic research areas or topics
77 (e.g., indigenous health or cancer) to guide overall research activity and commissioning, and
78 2) selecting specific research projects for funding from proposals put forward by researchers.[6,
79 7]

80 Most research projects in Australia are investigator-initiated and researchers must seek
81 financial support for their proposals through research funding organisations (e.g., the National
82 Health and Medical Research Council (NHMRC)). However, the overall funds available for
83 research are limited compared to the number of submissions and decisions have to be made
84 about the best way to distribute research funds. Thus, funding organisations need to have a
85 transparent and systematic way to evaluate and prioritise research projects for funding.[5, 8, 9]
86 This is often done based on the assessments of the merits of the submitted proposals according
87 to the judgments of experts sitting on funding panels.[8, 10] In this process, submitted

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3 88 proposals are assessed and scored against predefined criteria with each criterion, or group of
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5 89 criteria, being assigned a weight reflecting its relative importance. Such practice corroborates
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8 90 with the recommendations of many international initiatives for setting research priorities where
9
10 91 the use of explicit and comprehensive criteria is encouraged to ensure that important
11
12 92 considerations are not overlooked during the selection process.[9, 11-14] In general, these
13
14 93 criteria may include burden of the disease, equity, scientific rigor, research team capabilities,
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16
17 94 innovation and impact of research results. The choice of criteria and the scoring system may
18
19 95 differ, depending on the needs of stakeholders involved in this exercise.[9, 11-14] Literature
20
21 96 examples on prioritising research topics using explicit criteria are abundant; [9, 11-14]
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24 97 however, there is a dearth of articles that provide a clear critical insight on the criteria used to
25
26 98 select research projects from research proposals competing for funding.[15]
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31 100 Whilst health research funding decisions in Australia rely heavily on the ability of
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33 101 research proposals to meet selection criteria, it is unknown what criteria are more commonly
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35 102 used by research funders, how these criteria and their weights vary across funding
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37 103 organisations, and whether these criteria are comprehensive enough to capture all important
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39 104 considerations to ensure high quality and value for money research. This knowledge is
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41 105 important to assess the current approach of selecting and funding research projects, and to guide
42
43 106 future efforts to optimise health research funding mechanisms in the country. Therefore, the
44
45 107 aim of this paper was to critically review the criteria considered by major Australian research
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47 108 organisations in their selection of health research projects for funding.
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53 110 **METHODS**

55 111 *Patient and Public Involvement*

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57 112 Patients and public were not involved
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3 113 We reviewed all research funding schemes listed on the Australian Competitive Grants
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5 114 Register (ACGR), which provides a comprehensive list of funding schemes that have been
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8 115 approved by the Australian Government as being competitive research grants.[16] The
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10 116 identified schemes were included if they were health related, active in 2017, and had clear
11
12 117 selection criteria which were publicly available on the funders' websites. Health research refers
13
14 118 to research with human health or medical purpose, including research on the aetiology,
15
16 119 diagnosis or management of disease, mental condition or behaviour in human. To focus on
17
18 120 schemes for funding research projects and programs, research schemes dedicated solely to
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20 121 training, capacity building, equipment or infrastructure were excluded. These include
21
22 122 fellowships, awards and scholarships as well as research and training centres.
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27 123 Data extracted included scheme name, year first implemented, funding organisation,
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29 124 selection criteria and the relative weight assigned to each criterion. Selection criteria were
30
31 125 grouped into five representative domains: relevance (i.e., why should we do it?, including the
32
33 126 burden of disease and level of existing knowledge), appropriateness (i.e., should we do it?,
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35 127 including scientific rigour and suitability to answer the research question), significance of
36
37 128 research outcomes (i.e., what will we get out of it?, including impact and innovation),
38
39 129 feasibility (i.e., can we do it?, including team quality and research environment), and cost-
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41 130 effectiveness (i.e., is the proposed research potentially good value for money?).[9, 12] The
42
43 131 domains were selected based on the lists of criteria and categories suggested in comprehensive
44
45 132 tools for research prioritisation including the Essential National Health Research Approach
46
47 133 (relevance, appropriateness, feasibility and significance),[12] Child Health and Nutrition
48
49 134 Research Initiative (answerability, effectiveness, deliverability, and impact),[11] and the
50
51 135 Checklist for Health Research Priority Setting (benefits, feasibility, and cost-effectiveness).[9]
52
53 136 Disagreements related to assigning criteria to their representative domains were either resolved
54
55 137 by discussion or the involvement of a third reviewer who was provided with the full assessment
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138 or selection criteria for consensus decision-making. A domain was counted under a given
 139 scheme if at least one criterion within that domain is reported in the selection criteria of that
 140 scheme. Table 1 provides a description of the representative domains.

141 **Table 1: Description of domains and relevant criteria**[9, 12]

Domain	Definition
Relevance	The key question for this domain is “why should we do it?” The proposed research is pertinent to the health problems of interest. It takes into consideration burden of disease, equity, alignment with national/organisational objectives and the level of existing knowledge in relation to the intervention.
Appropriateness	The key question for this domain is “should we do it?” The proposed research is well suited to answer the decision problem (i.e., answerability). It takes into consideration ethical, moral and legal acceptability, and scientific rigor.
Significance	The key question for this domain is “what will we get out of it?” It represents the benefit of implementing/translating the research results. It takes into consideration the impact on health, innovation, and ability to foster capacity building and collaboration.
Feasibility	The key question for this domain is “can we do it?” The focus is on the chances of research success. It considers team quality (track record) and capability, research environment, and the research plan.
Cost-effectiveness	The key question for this domain is “is the research cost-effective?” This theme focuses on the value for money of the research proposal and budget justification. It considers the costs and expected benefits of conducting research.

142

143 RESULTS

144

145 Thirty-six schemes met our inclusion criteria from 158 schemes listed on the 2017
 146 ACGR. Figure 1 summarises the review process.

147

Fig1: Flowchart of the review

148 One half of the schemes were under the NHMRC. Five schemes (14%) were
 149 specifically for research in cancer, four (11%) for dementia, four (11%) for mental health, and
 150 three (8%) for diabetes. A summary of the selection criteria considered by each scheme is
 151 presented in Table 2. Further details on the selection criteria and scoring weights are provided
 152 in supplementary file.

Table2: Selection criteria domains for schemes and funding organisations

Organisation and Scheme Name	Relevance			Appropriateness			Significance				Feasibility				Cost-effectiveness	
	Burden	National/Organisational Priorities	Existing Knowledge	Scientific Quality	Answerability	Ethical/Moral	Innovation	Impact	Translation/Implementation	Capacity/Collaboration	Research Team Quality	Environment	Stakeholders Involved	Research Plan	Budget Justification	Value for Money
NHMRC																
Boosting Dementia Research Grants[17]	-	✓	-	✓	-	-	✓	✓	✓	-	✓	-	✓	✓	✓	✓
Dementia Research Team Grants[18]	-	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	-	-
Development Grants[19]	✓	✓	-	✓	-	-	✓	✓	✓	-	✓	✓	-	✓	-	-
Global Alliance for Chronic Diseases- Chronic Lung Disease[20]	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-	✓	✓	-	-
Global Alliance for Chronic Diseases- Mental Disorders[20]	-	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	-	-
Global Alliance for Chronic Diseases-Type 2 Diabetes Countries[20]	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-	✓	✓	-	-
National Institute for Dementia Research Grants[21]	-	✓	-	✓	✓	-	✓	✓	✓	-	✓	✓	✓	✓	✓	✓
NHMRC/NSFC - Prediction and Treatment of Type 2 Diabetes [22]	-	✓	-	✓	✓	-	-	✓	✓	✓	✓	✓	-	✓	-	-
Northern Australia Tropical Disease Collaborative Research Programme[23]	-	-	-	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	-	-
Partnership Projects[24]	-	-	-	✓	✓	-	✓	✓	✓	-	✓	-	-	✓	-	-
Program Grants[25]	✓	-	-	✓	-	-	✓	✓	✓	✓	✓	✓	-	✓	-	-
Project Grants[26]	-	-	-	✓	-	-	✓	✓	✓	-	✓	-	-	✓	-	-
Targeted Call - Engaging Young Adults to Improve Eating Behaviours and Health Outcomes[27]	-	✓	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-
Targeted Call – Mental Health : Suicide Prevention in Aboriginal and Torres Strait Islander Youth[28]	-	-	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-
Targeted Call- Foetal Alcohol Spectrum Disorder among Aboriginal and Torres Strait Islander Peoples[29]	-	-	✓	✓	✓	-	-	✓	-	-	✓	-	✓	✓	-	-
Targeted Call- Preparing Australia for the Genomics Revolution[30]	-	✓	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-
Targeted Call-Wind Farms and Human Health[31]	-	✓	-	✓	✓	-	-	✓	✓	-	✓	-	✓	✓	-	-
Translational Research Projects for Improved Health Care[32]	-	✓	-	-	-	-	-	✓	-	-	✓	-	-	✓	-	✓
Cancer Australia																

1	Priority-Driven Collaborative Cancer Scheme[33]	-	✓	-	-	-	-	-	✓	✓	✓	✓	-	✓	-	-	-
2	Support for Cancer Clinical Trials Program-Existing National Cooperative	-	-	-	✓	-	-	-	-	✓	✓	-	-	-	-	✓	✓
3	Oncology Groups[34]	-	-	-	✓	-	-	-	-	✓	✓	-	-	-	-	✓	✓
4	National Breast Cancer Foundation																
5	Accelerator Research Grant[35]	-	✓	-	✓	-	-	-	✓	✓	-	✓	-	-	✓	-	-
6	Innovator Grant[36]	-	✓	-	✓	-	-	✓	✓	-	-	✓	-	-	✓	-	-
7	Department of Foreign Affairs and Trade																
8	Tropical Disease Research Regional Collaboration Initiative[37]	-	✓	-	✓	✓	-	-	✓	✓	✓	✓	-	-	✓	✓	✓
9	Alzheimer's Australia Dementia Research Foundation																
10	Dementia Grants Program[38]	-	-	-	✓	✓	-	✓	✓	-	-	✓	-	-	✓	-	-
11	Australian and New Zealand College of Anaesthetists																
12	ANZCA Research Grants Program[39]	-	-	-	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
13	Australian Rotary Health																
14	Mental Health Research Grants[40]	-	-	-	✓	-	-	✓	✓	-	-	✓	-	-	✓	-	-
15	Bupa Foundation																
16	Bupa Health Foundation[41]	-	-	-	-	-	-	-	✓	-	-	✓	-	-	✓	-	-
17	Cure for MND Foundation																
18	Translational Research Grants[42]	-	-	-	✓	-	-	-	✓	✓	-	✓	✓	-	✓	-	-
19	Diabetes Australia Research Trust																
20	General Grants[43]	-	-	✓	✓	-	-	✓	✓	✓	-	✓	-	-	✓	-	-
21	Healthway (Western Australian Health Promotion Foundation)																
22	Health Promotion Intervention Research Grants[44]	-	✓	✓	✓	-	-	-	✓	✓	✓	✓	-	✓	✓	✓	✓
23	HCF Research Foundation																
24	Health Services Research Grants[45]	✓	✓	✓	✓	-	-	-	✓	✓	-	-	-	-	✓	-	-
25	Motor Neurone Disease Research Institute of Australia																
26	Motor Neurone Disease Research Grants[46]	-	✓	-	✓	-	-	-	-	-	-	✓	-	-	-	-	-
27	Multiple Sclerosis Research Australia																
28	Research Grants[47]	-	✓	-	✓	✓	-	✓	✓	-	-	✓	-	-	✓	-	-
29	National Heart Foundation of Australia																
30	Vanguard Grants[48]	-	✓	-	✓	-	-	-	✓	✓	-	✓	✓	-	✓	-	-
31	Prostate Cancer Foundation of Australia																
32	New Concept Grant[49]	-	-	-	✓	-	-	✓	✓	-	-	✓	✓	-	✓	-	-
33	The Movember Group and beyondblue																
34	Australian Mental Health Initiative[50]	-	✓	-	✓	✓	-	✓	✓	✓	-	✓	-	✓	✓	-	-

NHMRC: National Health and Medical Research Council, NSFC: National Natural Science Foundation of China, ANZCA: Australian and New Zealand College of Anaesthetists, MND: Motor Neurone Disease, HCF: The Hospitals Contribution Fund of Australia.

1
2 156 The most commonly used criteria were research team quality and capability (94%), research
3
4 157 plan clarity (94%), scientific quality of the proposal (92%) and research impact (92%). Criteria
5
6 158 considered less commonly were existing knowledge (22%), fostering collaboration (22%), research
7
8 159 environment (19%), budget justification (17%), value for money (14%), disease burden (8%) and
9
10
11 160 ethical/moral considerations (3%). When selection criteria were grouped into relevant domains, all
12
13 161 schemes considered feasibility criteria, 94% of the schemes considered significance, 92% considered
14
15 162 appropriateness, 72% considered relevance, and only 17% considered cost-effectiveness. Only five
16
17
18 163 schemes (14%) considered all five domains; namely, NHMRC National Institute for Dementia
19
20 164 Research Grants, NHMRC Boosting Dementia Research Grants, Cancer Australia Clinical Trials
21
22 165 Program, and the Department of Foreign Affairs and Trade Tropical Disease Research, and Health
23
24
25 166 Promotion Intervention Research Grants. Figure 2 depicts the distribution of selection criteria.

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27
28 167 **Fig2: Overall research criteria and their representative domains**

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31 168 When reported, the relative weights for the selection criteria also varied across schemes with
32
33 169 20-75% for feasibility, 20-60% for each appropriateness and significance, 15-33% for value for
34
35 170 money and 5-30% for relevance criteria.

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38 171 **DISCUSSION**

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40 172
41
42 173 Using a predefined set of selection criteria is a transparent approach to select and prioritise
43
44 174 high quality research projects for funding. Typically, the relevance of research proposals is gauged
45
46 175 with criteria that are mostly related to the project's ability to advance knowledge;[7] however, these
47
48
49 176 criteria should also reflect the mandate of the funding organisation and the purpose of the funding
50
51 177 scheme.[9, 12] A broad range of criteria were reported in the included schemes with a clear focus on
52
53 178 the quality of the research team, research plan, scientific rigor, impact, and
54
55
56 179 translation/implementation potential. The identified schemes, within the same organisation and across
57
58 180 organisations, had variable selection criteria and scoring weights. When grouped into representative
59
60 181 domains, funding organisations in Australia appear to focus on research relevance, appropriateness,

1
2 182 significance, and feasibility; however, cost-effectiveness of research projects was largely overlooked.
3
4 183 The observed variation in criteria and scoring weights in our review may be justified by the different
5
6 184 emphasis placed on certain aspects to achieve the outcomes sought under each scheme. For instance,
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8
9 185 collaborative and partnership schemes focused on partnership strengths, collaborative gains, and team
10
11 186 integration.

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13
14 187 The only aspect that was considered by all schemes was research feasibility with a clear
15
16 188 emphasis on the quality of the research team. Team quality and capability (often based on past
17
18 189 performance) is vital to ensure that the funded research projects can be effectively conducted within
19
20
21 190 the time and budget specified; nevertheless, over relying on this criterion may result in giving
22
23 191 disproportionate share of funding to established teams at the expense of more novel and innovative
24
25 192 projects. This bias can be reduced by introducing initiatives that fund innovative research ideas with
26
27
28 193 high impact potential such as the ‘Grand Challenges’ initiative and the NMRC ‘Ideas Grants’.[5, 6]
29
30 194 Notably, there are important criteria that were not considered by most of the included schemes. Equity
31
32 195 considerations were not explicitly mentioned as a selection criterion, and ethical/moral considerations
33
34 196 were only considered in one scheme. This might be explained by the implicit assumptions that all
35
36
37 197 submitted proposals will be approved by ethics committees and that equity is addressed by targeted
38
39 198 research grants (e.g., Research in Aboriginal and Torres Strait Islanders) or considered during final
40
41 199 deliberations to select proposals for funding. However, without clarity about where the responsibility
42
43
44 200 for ethical and equity considerations lies there is the potential for these criteria to be overlooked.

45
46
47 201 There has been a shift away from exclusive technical merit-review of proposals towards
48
49 202 relevance of research funding as judged by multiple stakeholders.[7, 51, 52] Research organisations,
50
51 203 particularly if publically funded, are increasingly expected to make the best use of taxpayers’ money
52
53 204 to increase value and reduce waste when research priorities are set.[53, 54] For example, Chalmers
54
55
56 205 *et al.* recommended to engage potential users of research in research prioritisation, justify additional
57
58 206 research by systematic reviews to show what is already known, and to periodically monitor and
59
60 207 analyse impact of funded research.[4, 5, 55] Around 40% of the schemes in our study considered

1
2 208 stakeholders' involvement (i.e., consumers and/or clinicians); however, the level of stakeholders'
3
4 209 engagement and influence on funding decisions was unclear. Considering the needs and inputs of
5
6 210 various stakeholders such as patients, caregivers, clinicians and decision makers is essential to fund
7
8 211 research that is useful to solve real-life problems. The experience of the Patient-Centered Outcomes
9
10
11 212 Research Institute (PCORI) in the US suggested that involving patients and stakeholders alongside
12
13 213 scientists in reviewing research applications is influential in panel discussions and merit review
14
15 214 outcomes.[52, 56] Despite its importance to avoid research duplication, only 22% of the identified
16
17
18 215 schemes considered existing knowledge, but none of the schemes explicitly required a systematic
19
20 216 review of literature to demonstrate knowledge gaps. Although conducting systematic reviews to
21
22 217 identify knowledge gaps may not be required when responding to targeted research calls or when
23
24
25 218 research is commissioned, since evidence review is often conducted by the commissioning
26
27 219 organisations, showing what is already known should be required by researchers submitting
28
29 220 investigator-initiated proposals. Our results echo the findings of a review of the extent to which 11
30
31 221 international organisations.[3] In that review, only one organisation required reference to relevant
32
33
34 222 systematic reviews in all funding applications and four funders required systematic reviews for
35
36 223 funding clinical trials.[3]

37
38
39 224 Another important value aspect is the impact of funded research. Research impact broadly
40
41 225 refers to generated benefits in terms of knowledge production, informing policy, capacity-building,
42
43 226 health benefits, and broader social and economic benefits.[53, 57] The presence of multidimensional
44
45
46 227 benefits reflects how the definition of impact varies with the perspectives of different stakeholders as
47
48 228 patients, clinicians, government, industry and academia.[53, 57, 58] The majority of the schemes in
49
50
51 229 our review considered research impact as a funding criterion with elements including advancing
52
53 230 knowledge, improving health outcomes and scientific publications; however, the schemes did not
54
55 231 specify how these benefits should be measured and presented in funding proposals. Greenhalgh and
56
57
58 232 colleagues have reviewed established approaches to measure impact (e.g., Research Impact
59
60 233 Framework, Canadian Academy of Health Sciences, and UK Research Excellence Framework).[53]

1
2 234 They have concluded that approaches to impact assessment differed according to the circumstances
3
4 235 and purpose of funding, they also noted that the most robust approaches are complex and labour-
5
6 236 intensive and called for research on research impact.[53] Of note, most of these approaches were
7
8 237 designed to measure research impact retrospectively, that is to evaluate the benefits of particular
9
10
11 238 research programs that have already been conducted; notwithstanding, funding organisations and
12
13 239 researchers need prospective approaches to infer the benefit of new research to support research
14
15 240 funding decisions. Incorporating impact evaluation frameworks into the priority-setting processes is
16
17
18 241 a necessary requirement that should be studied.[7]

19
20
21 242 Importantly, funding organisations may implicitly assume that selecting high impact projects
22
23 243 would ensure value for money; nevertheless, value for money cannot be established without explicitly
24
25 244 comparing the costs and expected benefits of proposals competing for funding.[6, 59, 60] This is
26
27
28 245 because research budgets are finite and decisions must be made about how to allocate these funds
29
30 246 (i.e., which research proposals should be funded) to maximise benefits. Failure to consider this aspect
31
32 247 brings the risk of funding research projects where the costs of conducting research outweigh the
33
34 248 expected research benefits (i.e., research projects that are not cost-effective). This would result in
35
36
37 249 ‘opportunity cost’, which is the benefit forgone elsewhere by adopting suboptimal choices.[61]
38
39 250 Interestingly, none of the schemes that required demonstration of value for money provided
40
41 251 guidelines on how the cost-effectiveness of research projects should be performed and presented. Of
42
43
44 252 note, there are rigorous analytical methods to prospectively quantify the expected benefits of research
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46 253 on improving health outcomes, the key analytical approaches are the ‘prospective payback of
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48 254 research’ (a similar approach to return on investment) and the value of information approach.[6, 8]
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51 255 Under the payback approach, the value of a research study is typically inferred from its ability to
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53 256 result in a beneficial change in clinical practice.[62] The value of information approach, on the other
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55 257 hand, considers the uncertainty in the relevant available evidence (e.g., from systematic reviews and
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58 258 meta-analyses) and the consequences of this uncertainty (e.g., implementing a suboptimal
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60 259 intervention).[59, 63] Research benefits calculated by these approaches are scaled up by considering

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2 260 the population expected to benefit from research results over time, and these benefits are compared
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4 261 with research budget to inform cost-effectiveness.[60, 64] It should be acknowledged; however, that
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6 262 assigning monetary value to research benefits and conducting economic evaluation of research
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8 263 proposals may not be acceptable or feasible (e.g., due to capacity considerations) by some
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11 264 jurisdictions. Therefore, the decision making context and the availability of resources to conduct such
12
13 265 analyses should be carefully considered before incorporating these approaches into priority-setting
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15 266 processes. Furthermore, it should be emphasized that the cost-effectiveness criterion should not be
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18 267 the only consideration when making research funding decisions. It is recommended that cost-
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20 268 effectiveness be used to supplement (i.e., in combination with) other considerations that deemed
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22 269 important to the stakeholders.[8, 57]

24
25 270 A limitation to our work is that we only reviewed active grant schemes listed on the ACGR;
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27
28 271 and therefore, some grant schemes may not have been included in our review; however, the ACGR
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30 272 is a comprehensive registry of major research grants by leading funding organisations in Australia.
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32 273 Additionally, it is noted that selection criteria, and schemes, change over time to meet political and
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34 274 administrative objectives. For example, the NHMRC is revising grant schemes as well as the selection
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37 275 criteria and processes for a new series of grants to commence funding in 2019.[65] In addition, our
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39 276 review was limited by the amount of publicly available information for each scheme, and thus, we
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41 277 could not extract some important elements as scheme budgets and the knowledge generation and
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44 278 translation frameworks adopted by various funding organisations. The next step for this research
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46 279 would be to engage with funding organisations to gain further insights on their approaches to prioritise
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48 280 research proposals for funding.

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51 281 In conclusion, health care research is vital to improve health; however, there is a need to
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54 282 ensure that funded research is relevant and value for money. In selecting research projects for funding,
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56 283 Australian research funding organisations focus on research appropriateness, significance and
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58 284 feasibility; nevertheless, other important criteria should not be overlooked such as equity and
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2 285 stakeholders' engagement. Importantly, research funding decisions should include an assessment of
3
4 286 value for money in order to maximise return on research investment.
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7 287 **ACKNOWLEDGMENTS**

8
9 288 The authors acknowledge Menzies Health Institute Queensland, Cancer Council Queensland and
10
11 289 the Prostate Cancer Foundation of Australia for funding this project. The authors thank Professor
12
13 290 Joanne Aitken for her contribution to this manuscript.
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16 291 **COMPETING INTERESTS**

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19 292 The authors have no competing interests.
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22 293 **FUNDING**

23
24
25 294 Haitham Tuffaha is supported by an Australian National Health and Medical Research Council
26
27 295 (NHMRC) fellowship (GNT1121232). This project is funded by Menzies Health Institute
28
29
30 296 Queensland and the Prostate Cancer Foundation of Australia.
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33 297 **CONTRIBUTORSHIP STATEMENT**

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35
36 298 Haitham Tuffaha and Paul Scuffham conceptualised the manuscript. Haitham Tuffaha and
37
38 299 Najwan El-Saifi conducted the review of funding criteria and drafted the manuscript. Paul
39
40 300 Scuffham and Suzanne Chambers critically reviewed the findings. All authors contributed to the
41
42 301 writing, review and approval of the final version of the manuscript.
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45 302 **DATA SHARING STATEMENT**

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48 303 No Additional Data
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51 304 **REFERENCES**

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For peer review only

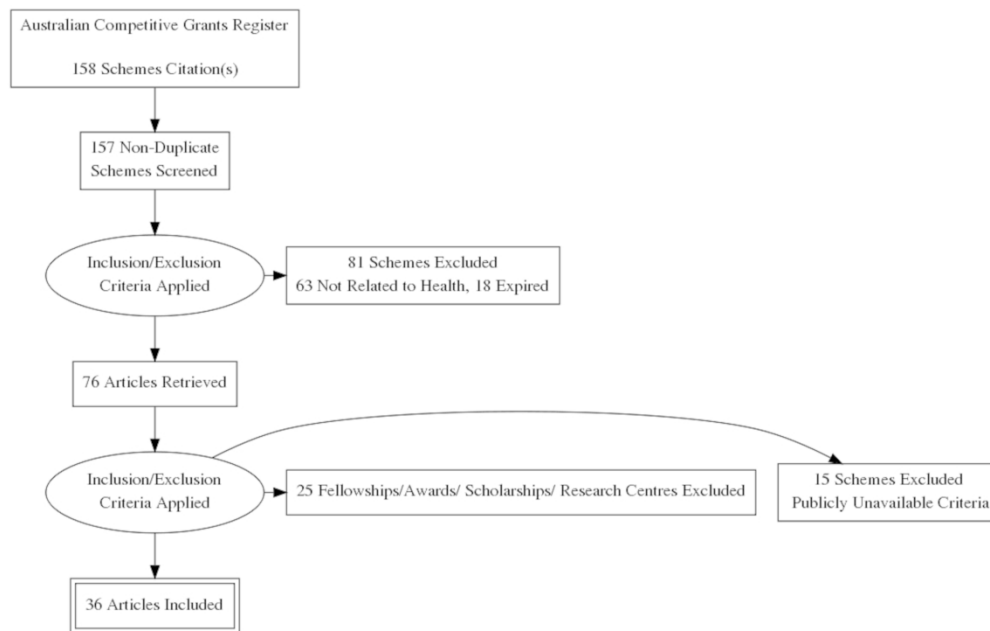


Fig1: Flowchart of the review

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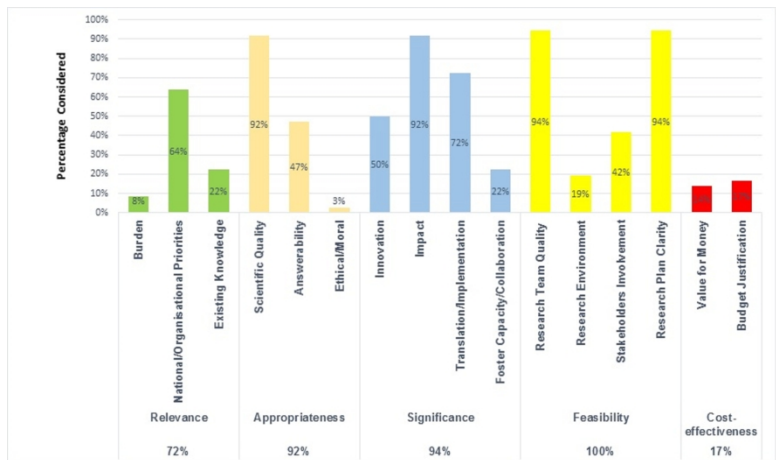


Fig2: Overall research criteria and their representative domains

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Summary of selection criteria and scoring weights of the included schemes

Agency	Scheme name	Year listed	Assessment criteria	Score
NHMRC	Partnership Projects	2017	Track record of investigators relative to opportunity	25%
			Scientific quality of the proposal and methodology	25%
			Relevance and likelihood to influence health and research policy and practice	25%
			Strength of partnership	25%
NHMRC	Program Grants	2017	Team research achievements (publications, grants, awards)	60%
			Research strategy (quality, addresses important issues, impact, innovation, achievable)	20%
			Collaborative gain (team integration, training and mentoring)	20%
NHMRC	Project Grants	2017	Scientific quality (research plan clarity, appropriateness and feasibility)	50%
			Significance of outcomes and/or innovation of the concept (advance knowledge, outcomes. translation, publications)	25%
			Team quality and capability relative to opportunity (expertise, reputation, achievements)	25%
NHMRC	Global Alliance for Chronic Diseases (GACD) ^a	2014	Relevance and quality of project (scheme objectives, appropriate and feasible methods, innovative, ethical)	25%
			Quality of team (high quality track-record, capacity building, public engagement)	25%
			Implementation plans/feasibility (challenges identified, inequality gaps considered)	25%
			Potential impact (outcome utilization, economic impact assessed)	25%
NHMRC	NHMRC's Targeted Call for Research Program ^b	2013	Scientific quality and likelihood to answer the research question(s) (relevant, feasible consumers engaged)	40-60%
			Whether the team has all the necessary skills and expertise to achieve the expected outcomes	20-50%
			Significance of the project and expected outcomes	0-40%
NHMRC	Dementia Research Team Grants	2014	Generate new knowledge that leads to improved health outcomes (clarity, quality of methods, feasibility, innovation)	25%
			Record of research and translation achievement - relative to opportunity (contribution to the field of research, research outputs)	25%
			Facilitate collaboration (collaboration, integration and cohesiveness of the team)	20%
			Promote effective transfer of outcomes into health policy and/or practice (quality of the plan, involvement of end user)	20%
			Develop the health and medical research workforce	10%
NHMRC	Development Grants	2017	Scientific merit of the proposal (quality of the scientific research)	40%
			Record of commercial achievements (relative to opportunity)	20%
			Commercial potential (high impact, innovation, relevant to schemes objectives)	40%
NHMRC		2015	Relevance to the aims of the round and significance of outcomes (relevant to scheme objectives, potential to improve outcomes)	30%

	National Institute for Dementia Research Grants		Project design, methods and analyses (feasible and suitable environment, consumers and clinicians engaged)	30%
			Budget justification and value for money (proposal demonstrates that it is cost effective)	15%
			Team quality and capability relevant to the project (team capacity, ability, and expertise)	25%
NHMRC	NHMRC/NSFC, Prediction and Treatment of Type 2 Diabetes in China and Australia	2015	Scientific quality of the project including feasibility (fits within aims of the scheme, feasible, appropriate methods)	25%
			Significance of the expected outcomes (impact on health, advance knowledge)	25%
			Track record of the team (team capability, track-record)	25%
			Added value of international collaboration (collaboration, transfer of knowledge)	25%
NHMRC	Northern Australia Tropical Disease Collaborative Research Program	2016	Generate new knowledge that leads to improved health outcomes	20%
			Promote effective transfer of research outcomes into health policy and/or practice	20%
			Develop the health and medical research workforce	20%
			Facilitate collaboration	20%
			Record of research and translation achievements - relative to opportunity	20%
NHMRC	Translational Research Projects	2017	Significant relevance to the health system	NA
			Inform evidence-based improvement to health care	NA
			Outcomes for patients, and/or efficiency in healthcare and/or cost savings	NA
			Includes a plan for dissemination of results within the healthcare sector	NA
			Represents value for money	NA
			Excellent level research team	NA
NHMRC	Boosting Dementia Research Grants	2017	Relevance to the aims of the round and significance of expected outcomes	30%
			Project design, methods and analyses (clear, coherent, involvement with consumers, innovation, feasible, translation/impact)	30%
			Project justification and value for money (demonstrate value for money)	15%
			Team quality and capability relevant to the project (team strength, reputation, contributions)	25%
Department of Foreign Affairs and Trade	Tropical Disease Research Regional Collaboration Initiative	2017	Activity effectiveness and value for money (strengthen research capability and collaboration, clear objectives, budget justified)	50%
			Organisational effectiveness (record of strengthening research collaboration)	50%
Cancer Australia	Priority-Driven Collaborative Cancer Scheme	2017	Team quality and capability relevant to the application	40%
			Outcomes and impact of current proposal	25%
			Translation of research	10%
			Collaborations	15%
			Consumer involvement	10%

Cancer Australia	Support for Cancer Clinical Trials Program Grant	2013	National multi-disciplinary membership, governance structure, data and quality, capacity building, collaboration, translation	33.3%
			How the funding will be utilized	33.3%
			Budget and value for money	33.3%
Alzheimer's Australia Dementia Research Foundation	Dementia Grants Program	2017	Scientific merit and quality (relevance, clarity and suitability of methods and plan)	50%
			Track record and independence of the applicant	30%
			Innovation/originality	20%
			The Scientific Panel will also consider the feasibility of proposed projects	
Australian and New Zealand College of Anaesthetists	Project Grants	2017	Scientific merit, design/methods, track record, originality, feasibility and international competitiveness	NA
Australian Rotary Health	Mental Health Research Grants	2017	Scientific excellence of the project	NA
			Innovation of the project	NA
			Track record of the applicant	NA
			Feasibility, including relevant partnerships	NA
			Practical benefits to the mental health of the community	NA
Bupa Foundation (Australia) Limited	Bupa Health Foundation	2017	Direct impact on health outcomes	NA
			Timing of delivery of results	NA
			Justification of funding	NA
			Study/program design	NA
			Reputation of organisation	NA
Cure for MND Foundation	Translational Research Grants	2017	Research strategy and feasibility	50%
			Impact and transition potential	25%
			Personnel and budget	25%
Diabetes Australia Research Trust	General Grants	2017	Research methods and quality	40%
			Potential research outcomes	60%
Healthway (Western Australian Health Promotion Foundation)	Health Promotion Intervention Research Grants	2017	Ability to directly improve health and community outcomes in priority health areas	NA
			Contribution of the research to best practice in health promotion	NA
			The quality of the translation plan	NA
			End-user partnerships and collaboration	NA
			Soundness of rationale and methodology	NA
			Track record and capability of research team	NA
HCF Research Foundation	Health Services Research Grants	2017	Scientific merit (design, methodology, feasibility, budget)	40%
			Relevance to HCF objectives (translation, response to knowledge gaps, improve health)	40%
			General (repeat other studies/ongoing studies, burden of disease)	20%
	Grants-in-aid	2017	Track record of the applicant	NA

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Motor Neurone Disease Research Institute of Australia			Strength of the research plan	NA
			Relevance to Motor Neurone Disease	NA
Multiple Sclerosis Research Australia	Research Grants	2017	Relevance to Multiple Sclerosis	NA
			Significance (value and novelty)	NA
			Feasibility of methods	NA
			Track record of applicants	NA
National Breast Cancer Foundation	Innovator Grant	2017	Novelty of the project	50%
			Track record of applicant	20%
			Quality and feasibility	20%
			Relevance to National Breast Cancer Foundation research priorities	10%
National Breast Cancer Foundation	Accelerator Research Grant	2016	Translational potential and impact on breast cancer outcomes	50%
			Track record of applicant team	20%
			Scientific quality and feasibility	20%
			Relevance to National Breast Cancer Foundation research priorities	10%
National Heart Foundation	Vanguard Grant	2017	Track record of applicants	NA
			How well the application addresses the purpose of the award	NA
			Quality of the research proposal	NA
			Feasibility of the research proposal	NA
			Potential to produce tangible outcomes	NA
Prostate Cancer Foundation of Australia	New Concept Grant	2017	Track record of investigator team	NA
			Scientific and technical merit of the research question, feasibility, design and methodology.	NA
			Innovation	NA
			Potential impact on prostate cancer	NA
			Research environment (suitability, expertise and collaboration)	NA
The Movember Group and Beyondblue	Australian Mental Health Initiative	2013	Alignment and fit with Movember’s strategic goals	NA
			Significance/innovation of the project (advance management, address significant areas)	NA
			Project proposal (clarity, achievability, collaboration, consultation with stakeholders, plan, knowledge translation)	NA
			The project team (proven expertise, capability, record)	NA

NHMRC: National Health and Medical Research Council, NSFC: National Natural Science Foundation of China, MND: Motor Neurone Disease, HCF: The Hospitals Contribution Fund of Australia.

^a Global Alliance for Chronic Disease Grants include: Request for Applications on Type 2 Diabetes in Low and Middle Income Countries, Request for Applications on the Prevention and Management of Chronic Lung Disease in Middle and Low Income Countries and Indigenous Communities in Australia and Canada, Request for Prevention and Management of Mental Disorders in Low and Middle Income Countries and Indigenous Communities in High Income Countries.

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3 ^bTargeted calls include: Targeted Call for Research into Wind Farms and Human Health, Targeted Call for Research into Preparing Australia for the Genomics Revolution in Health Care, Targeted
4 Call for Research into Engaging and Retaining Young Adults in Interventions to Improve Eating Behaviours and Health Outcomes, Targeted Call for Research into Fetal Alcohol Spectrum
5 Disorder among Aboriginal and Torres Strait Islander Peoples, Targeted Call for Research into Mental Health : Suicide Prevention in Aboriginal and Torres Strait Islander Peoples
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