

# Concocting that Magic Elixir: Successful Grant Application Writing in Dissemination and Implementation Research

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## Abstract

**Background:** This paper reports core competencies for dissemination and implementation (D&I) grant application writing and provides tips for writing a successful proposal.

**Methods:** Two related phases were used to collect the data: a card sorting process among D&I researchers and an expert review among a smaller set of researchers. Card sorting was completed by 123 respondents. In the second phase, a series of grant application writing tips were developed based on the combined 170 years of grant review experience of the writing team.

**Results:** The card sorting resulted in 12 core competencies for D&I grant application writing that covered the main sections in a grant application to the US National Institutes of Health: (a) *specific aims* that provide clear rationale, objectives, and an overview of the research plan; (b) *significance* that frames and justifies the importance of a D&I question; (c) *innovation* that articulates novel products and new knowledge; and (d) *approach* that uses a relevant D&I model, addresses measurement and the D&I context, and includes an analysis plan well-tied to the aims and measures.

**Conclusions:** Writing a successful D&I grant application is a skill that can be learned with experience and attention to the core competencies articulated in this paper. *Clin Trans Sci* 2015; Volume 8: 710–716

**Keywords:** dissemination and implementation research, grant writing, research, grant review, translational research

## Introduction

In the United States, the largest funder of health-related dissemination and implementation (D&I) research is the National Institutes of Health (NIH).<sup>1</sup> These D&I program announcements within NIH are also open to international investigators interested in studying the most effective strategies for translating the lessons learned from science into the practice and policy contexts in their countries. While D&I research has grown in visibility in the United States and globally,<sup>1–3</sup> it is still relatively new, with a standing study section for D&I research that was only established in 2010.<sup>1</sup> Challenges for continuing to grow the field remain. For example, with the NIH budget now flat for five years, there is less funding available for all grants, including D&I grants, and success rates overall are at record lows.<sup>4</sup> In Canada, the Canadian Institutes for Health Research has had a long standing interest in knowledge translation research,<sup>5</sup> although their grant making ability has been impacted by relatively low funding, and recently some Canadian disease specialty charities have stepped up to fund Knowledge to Action research.<sup>6</sup> With these recent trends and likely continued restrictions on federal funding across many countries, there is more of a need than ever in knowing how to construct the strongest D&I grant application possible.

There are many similarities between what constitutes an outstanding application for D&I research and those for other areas of research. However, there are several distinctions, which are important to take into account when developing a D&I grant application. First, there is a continuing need to determine what to implement. This involves defining what is meant by an “evidence-based” intervention,<sup>7,8</sup> which typically is what D&I

research aims to implement or disseminate. Typically, the gold standard for labeling an intervention approach as “evidence-based” is a systematic review (e.g., the US Guide to Clinical Preventive Services, a Cochrane review). However, while an intervention approach may be deemed evidence-based in a systematic review of individual intervention research studies, the individual intervention programs may be more or less effective and applicable to the context being addressed in the D&I research application. Moreover, this standard is likely to vary according to discipline and the maturity of the body of intervention research literature. Second, success in D&I research often requires stakeholder involvement in the research or evaluation process (so-called practice-based research).<sup>9–11</sup> To a greater extent than most other research fields, D&I applications benefit from the explicit involvement of diverse stakeholder perspectives. The engagement of stakeholders early in a project can have many benefits, including identification of effective D&I approaches and designing your research in a way that makes it useful for practice and policy audiences. A third area of importance involves selection of a D&I framework or model. There are many overlapping theories and frameworks for D&I research,<sup>12,13</sup> and the selection of the most appropriate framework for a D&I study is complex and iterative. And finally, in many areas of D&I research, measures are not well developed<sup>14</sup> suggesting the continued opportunity to develop and test new measures/endpoints.

Beyond the obvious goal of obtaining funding, writing a research grant application serves several other important purposes. It forces the investigative team to clarify the research question(s)

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DOI: 10.1111/cts.12356

or specify hypotheses and focuses efforts on how to best answer these questions or test these hypotheses. Grant application writing can also help the team to identify key collaborators or stakeholders who will bring new disciplines, skills, and innovations to a project. The process of developing a grant application often highlights the need for pilot data to build the foundation for a larger study. Finally, in reviewing existing literature (the early section of a grant application), a team might gain new knowledge that highlights gaps in the evidence, and thus helps to focus the research question toward the greatest feasible contribution to needed new knowledge. All of these functions require skills and competencies, and will increase the chances of getting funding as well as create the strongest possible D&I science.

Building on previous guidance on grant application writing<sup>15-17</sup> and as part of our training program (Mentored Training for Dissemination and Implementation Research in Cancer [MT-DIRC]),<sup>18</sup> this paper reports on a set of core competencies for D&I grant application writing and summarizes a series of tips for writing a successful D&I proposal. While this paper is oriented toward the US NIH processes, the general structure should hold for many funders, spanning various agencies and regions across the globe.

## Methods

There are two related phases that were used to collect the data for this project: a card sorting process among D&I researchers and an expert review among a smaller set of researchers.

### Card sorting

We employed a card sorting method to identify grant writing competencies. Card sorting is commonly used for user testing of websites and is increasingly used by researchers to quickly organize and rate ideas.<sup>19</sup> To begin the card sorting process, a group of core faculty members ( $n = 7$ ) developed an initial list of 33 D&I grant competencies. These complemented a larger set of D&I research competencies, reported on elsewhere.<sup>20</sup> An expert panel ( $n = 26$ ) across the United States, Canada, and Australia received an email with this initial list. Feedback was compiled and incorporated iteratively into a final list that would be used for the next stage of the project. In the next phase, card sorting was conducted with a total of 300 individuals who were selected from among participants in two competitive national D&I training programs and a local D&I research network: (1) the Implementation Research Institute, an NIH-funded training grant in mental health research;<sup>21</sup> (2) the Training Institute for Dissemination and Implementation Research in Health (TIDIRH), an NIH D&I research training across multiple disciplines;<sup>22</sup> and (3) an internal Washington University D&I research network (the Washington University Network for D&I Research [WUNDIR]).<sup>23</sup> Using the “Question & Sort” feature of Qualtrics, participants were asked to place each competency into one of three skill levels (statement skill rating): “beginner,” “intermediate,” or “advanced.” For example, a “beginner” competency would be a place to start and a skill set that is perceived to be easier to develop. Raters were also asked to self-rate themselves according to their level of expertise in D&I research from beginner to advanced (respondent skill rating). Participants were given 3 weeks to complete the card sorting. The average completion time for card sorting process was 15 minutes. A total of 123 respondents completed the card sorting. The mean score was calculated for each competency and then sorted into tertiles based on these scores. To check for

agreement across statement skill ratings, one-way ANOVA was used to determine if there were statistically significant differences in how respondents grouped competencies based on respondent skill ratings.

### Expert review

In the second phase of the project, a series of grant application writing tips were developed based on the combined 170 years of grant review experience of the writing team (the authors of this paper). The lead investigator (RCB) summarized an initial set of recommendations; these were reviewed and expanded upon based on input from the writing team and three presentations (a grant writing session at TIDIRH in July 2014 and brainstorming sessions at WUNDIR in March 2015 and MT-DIRC in June 2015).

### Findings from Card Sorting

The card sorting resulted in 12 core competencies for D&I grant application writing that are presented across the main sections in an NIH grant application (aims, significance, innovation, approach, and human subjects; *Table 1*). The competencies were allocated across these sections by the author team. Based on perceptions of how difficult each skill is to develop, four competencies were rated at the beginner level, four were intermediate, and four were advanced. One competency (create a clear, rationale and realistic action plan for transforming research questions on D&I into grant proposals), showed a significant difference ( $p = 0.034$ ) in the way it was sorted based on the participants self-reported expertise level (i.e., beginners and intermediate researchers sorted it differently).

### Section-by-Section Advice

To complement and more fully operationalize the card-sorting data, we provide more detailed advice for writing a strong D&I grant application. In the text that follows, we exemplify this advice as applied to the NIH R01 mechanism, the most common vehicle for funding D&I research at NIH.<sup>1,14</sup> However, researchers outside the United States contributed to this paper, increasing the generalizability of the recommendations that follow. General guidance for each section is provided by NIH review criteria (*Table 2*).<sup>24</sup> In addition to the advice we provide, it is useful to review successful D&I grant applications, both their abstracts<sup>25</sup> and full applications.<sup>26</sup>

### Abstract

The abstract provides a key opportunity to make a positive first impression with reviewers. It is often written after the full application is drafted and should include: (1) a brief background of the project, focused on setting up the specific research question and aims; (2) specific aims, objectives, or hypotheses; (3) the significance of the proposed research and relevance to clinical care or public health; (4) the unique features and innovation of the project; (5) the methods to be used; (6) expected results; and (7) a description of how your results will affect other research areas, practice or policy to improve health. Certain features that might enhance your abstract for a D&I proposal include the potential impact of scaling up your evidence-based practice, innovative uses of D&I models/theory, and involvement of relevant stakeholders in D&I.

### Aims (recommended length = 1 page)

The aims section (some funders may use the term “objectives” instead of “aims”) is often the first section read in detail by

Grant proposal development		
Grant section	Competency (number)	Expertise*
<b>Aims</b>		
	Create a clear, rationale and realistic action plan for transforming research questions on D&I into grant proposal aims (A1).	B
<b>Significance</b>		
	Identify how to pose an innovative and significant D&I research question, justify its importance, describe the knowledge gap it addresses, and when possible, connect it to priorities of the funding agency (S1).	B
	Describe how to ground the proposal in an important quality gap that is addressable through the D&I of an evidence-based intervention, program or policy (S2).	B
<b>Innovation</b>		
	Articulate how to identify products from the D&I study, including implementation toolkits, to guide practice and policy (I1).	A
	Report on the consistency of the proposed practice change (to be addressed in the study) with the policy trends and priorities (I2).	A
<b>Approach</b>		
	Utilize an appropriate D&I model or framework to organize a proposal and integrate research questions with clear and measurable study objectives; aims; measures, and analysis strategies (AP1).	I
	Explain how to document or propose measurement of the setting's need, appropriateness and readiness of the practice change required through the D&I strategies addressed in the proposal (AP2).	I
	Identify measures that clearly assess the constructs of interest in the proposed study and are practical to apply in the proposed settings (AP3).	I
	Identify how to build a team with the expertise and experience for the proposed research, including D&I expertise and stakeholder experience (AP4).	I
	Create a strategic dissemination plan for various target audiences that goes beyond the traditional publications and presentation at meetings (AP5).	A
	Develop an analysis plan that addresses each specific aim and hypothesis and considers the different levels of analyses (AP6).	A
<b>Human Subjects</b>		
	Describe the ethical (human subjects) issues that are particular to and relevant for D&I research (HS10).	B

\*Statement skill rating: B = beginner; I = intermediate; A = advanced.

**Table 1.** Dissemination and implementation grant application core competencies, derived from card sorting, 2014.

reviewers assigned to read and review your application, and may be the only section read by other reviewers on the committee, so this page is critical for setting up your study. In most applications, you should include 2–4 *realistic* aims, and manage reviewer expectations by not overpromising. The aims section should frame the full proposal; you should address your aims throughout the proposal (including in the D&I conceptual framework, measures, and analyses). Grant application writers sometimes conflate the aims (i.e., the D&I science you want to accomplish), which is the primary focus of this section, with the activities (how you will accomplish the aims). Therefore, it is often useful to separate these on the aims page. It is often helpful to provide a brief rationale for each aim, and then to follow the aims with a sentence for each that says globally how they will be accomplished, followed by a sentence or two that asserts the importance of anticipated findings (see *Table 1*, competency A1). If you are conducting a larger, R01-scale project, it is often expected that the work is hypothesis-driven, and thus you should articulate clear hypotheses when possible. Aims should relate to each other and follow a logical order but should also be independent so if the early work is

delayed or goes differently than planned, it does not negate accomplishing the later aims.<sup>27</sup>

### **Significance (recommended length = 1–2 pages)**

The significance section defines the scope of the problem (e.g., the gap in the literature being addressed, the incidence and/or prevalence of the condition under study, costs, potential cost savings) and its importance to D&I science. It may be useful to make use of the epidemiologic concepts of attributable risk<sup>28</sup> (or for interventions, the prevented fraction<sup>29</sup>). This section should include a careful and brief review of the literature to set up the study (in particular, highlighting the source and scientific basis for your evidence-based intervention). It should highlight the void(s) in the literature to be filled and how filling this gap will improve health and/or eliminate health disparities (e.g., see competency S1 in *Table 1*). For a D&I grant application, the significance section often describes the potential impact of “scaling up” of an evidence-based intervention.<sup>30</sup> To show you are filling an unfilled niche, you might make use of RePORTER<sup>25</sup> to see what is already funded on related topics; a funding agency generally will not fund two

Domain subdomain	Key considerations
Overall impact	The likelihood for the project to exert a sustained, powerful influence on the research field(s) involved, in consideration of the following review criteria (subdomains)
Significance	<ul style="list-style-type: none"> <li>• Does the project address an important problem or a critical barrier to progress in the field?</li> <li>• If the aims of the project are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved?</li> <li>• How will successful completion of the aims change the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field?</li> </ul>
Investigator(s)	<ul style="list-style-type: none"> <li>• Are the PD/PIs, collaborators, and other researchers well suited to the project?</li> <li>• If established, have they demonstrated an ongoing record of accomplishments that have advanced their field(s)?</li> <li>• If the project is collaborative or multi-PD/PI, do the investigators have complementary and integrated expertise; are their leadership approach, governance and organizational structure appropriate for the project?</li> </ul>
Innovation	<ul style="list-style-type: none"> <li>• Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions?</li> <li>• Are the concepts, approaches or methodologies, instrumentation, or interventions novel to one field of research or novel in a broad sense?</li> <li>• Is a refinement, improvement, or new application of theoretical concepts, approaches or methodologies, instrumentation, or interventions proposed?</li> </ul>
Approach	<ul style="list-style-type: none"> <li>• Are the overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims of the project?</li> <li>• Are potential problems, alternative strategies, and benchmarks for success presented?</li> <li>• If the project is in the early stages of development, will the strategy establish feasibility and will particularly risky aspects be managed?</li> </ul>
Environment	<ul style="list-style-type: none"> <li>• Will the scientific environment in which the work will be done contribute to the probability of success?</li> <li>• Are the institutional support, equipment, and other physical resources available to the investigators adequate for the project proposed?</li> <li>• Will the project benefit from unique features of the scientific environment, subject populations, or collaborative arrangements?</li> </ul>
Protections for human subjects	For nonexempt research, there are five review criteria: <ol style="list-style-type: none"> <li>1. risk to subjects,</li> <li>2. adequacy of protection against risks,</li> <li>3. potential benefits to the subjects and others,</li> <li>4. importance of the knowledge to be gained and,</li> <li>5. data and safety monitoring for clinical trials.</li> </ol>

**Table 2.** Review criteria of the National Institutes of Health.<sup>24</sup>

very similar proposals. This section should also note the scientific contributions needed to address the gap(s) (e.g. see competency S2 in *Table 1*).

#### **Innovation (recommended length = ½ to 1 page)**

Probably more than any other section in your grant application, innovation, like beauty, is in the eye of the beholder. Several concepts may help you highlight the innovation in your D&I grant application, including: (1) studying a population that has not been adequately reached by evidence-based interventions (e.g., addressing health disparities); (2) implementing a new method of adapting an intervention for different D&I contexts; (3) applying a particular scientific method that may be underused in D&I research (e.g., systems science, social network analysis); (4) using a theory or framework that has high generalizability to the broader D&I field but may be novel to the particular health field addressed in your application; (5) using a technology in a new way or with a new population; (6) testing the reliability and validity of new measures; or (7) a novel combination of the above (see competencies I1 and I2 in *Table 1*).

#### **Approach (recommended length = 9–10 pages)**

The Approach section is the core and longest part of your application. It is likely to have the largest bearing on whether or not you receive a fundable priority score. The approach builds on clearly articulated aims in a way that convinces the reviewers

of their importance and potential impact. In a review of over 32,000 NIH applications that were discussed and received final overall impact scores, a multiple regression analysis found that the *Approach* score was by far the criterion score best able to predict the overall impact score. The *Approach* section had a regression weight of 6.7, followed by significance (weight of 3.3), innovation (weight of 1.4), investigators (weight of 1.3), environment (weight of -0.1).<sup>31</sup>

The *Approach* section describes the project in detail covering competencies AP1–AP6 in *Table 1*. It includes the applicant's research team's preliminary (pilot) studies that are relevant to the proposed study (often used to show feasibility). For an R01-level proposal, pilot data are critical. This section also includes an overview of the research design and the methods, measures, and analyses to accomplish the specific aims. For a D&I study, it is important to describe the conceptual framework or model and incorporate its constructs throughout the proposal (e.g., in measures, evaluation). There are now over 60 models that can be used for D&I research<sup>13</sup> and an online tool is available to assist in selecting the most appropriate model (see: <http://dissemination-implementation.org/>).<sup>32</sup> In choosing a model, it is critical to link the constructs in your model with your aims, research activities, measures, and analytic plans.

The *Approach* describes the study team ("Investigators" in the review criteria); often a diverse team across multiple disciplines will improve a proposal. This section should show how your prior work leads you to, and prepares you to conduct, the proposed

study. Investigators new to D&I research should add more experienced D&I investigators to the team to provide assurance to reviewers that the team collectively has the needed expertise and experience. International applicants to NIH D&I research program announcements may wish to consider including US D&I researchers as Co-Principal Investigators or Co-Investigators to help support the relevance of the proposed study to US service delivery or policy contexts. Careful attention to providing well-written biosketches will enhance your chances for success.

For D&I research, it often is helpful to show how the focus of the methods, or even their ongoing application and the interpretation of the findings, is guided by stakeholder perspectives—the people with whom the evidence-based intervention is being implemented or disseminated.<sup>33,34</sup> Dissemination and implementation projects are typically conducted in collaboration with healthcare system or community partners. It is important to clearly identify the partners you are working with, describe the roles and responsibilities of the various parties, and include a letters of support from the partners, outlining their commitments to the project.

This section also describes the settings and procedures for recruitment and sampling. Important questions often include: Why these setting contexts? How will you recruit organizations and/or individuals? How will you obtain an adequate response rate? Have your measures been tested? This last question is often critical in D&I research because for many D&I studies, the measures are underdeveloped.<sup>35</sup> Some of the sources of measures and trade-offs in selecting measures are covered in more detail elsewhere.<sup>35,36</sup>

While addressing internal validity is critical to any grant application, for a D&I grant application, the issues of external validity can be equally, if not more, important.<sup>37</sup> There are many remaining research questions related to external validity—for example, which factors need to be taken into account when an internally valid intervention is implemented in a different setting or with a different population subgroup? How should the adaptation process take into account various contextual conditions? How will the adaptation of an evidence-based intervention impact its effectiveness in a new or expanded context?

There are numerous analytic methods essential for your D&I study. For example, D&I studies might randomize or assign exposure at the group level. There is a range of study designs that are acceptable in D&I science, depending on the study goals. A careful justification of the design selected is important.<sup>38</sup> It is critical to understand the statistical issues involved in use of complex study designs (e.g., between-cluster variation leads to a reduction in effective sample size, standard methods for sample size estimation may not apply). In addition, mixed methods research (i.e., systematically integrating qualitative and quantitative data) is increasingly used in D&I research. Quantitative methods are particularly helpful for testing *a priori* hypotheses about what can be measured, and qualitative methods are particularly helpful for understanding stakeholder perspectives, identifying emerging understanding, and assessing higher levels of multilevel interventions or contextual factors in which numbers are too small for statistical analyses.<sup>39</sup> To use these methods effectively, it is critical to follow state-of-the-art methods showing how and by whom data will be integrated, as outlined in two recent sources.<sup>39,40</sup>

The *Approach* section should also include plans for study management and dissemination of findings. The management plan can be brief but should present a figure with a time line and

the key tasks to be accomplished along with a leader for each of these tasks. For applications with multiple principal investigators, a more detailed management plan is required that includes issues such as roles of each principal investigator, communication plans (especially important when investigators are at geographically different locations), processes for making decisions, and processes for resolving conflicts. For a D&I grant, a strong dissemination plan is also important. This might follow principles of audience segmentation<sup>41</sup> and designing for dissemination (ensuring that grant products match the adopters' needs, assets, and time frames).<sup>42</sup>

### **Protections for Human Subjects (recommended length = 2–4 pages; generally not counted against page limits)**

A typical Human Subjects sections covers items such as (1) risk to subjects; (2) adequacy of protection against risks; (3) potential benefits to the subjects and others; (4) importance of the knowledge to be gained; and (5) data and safety monitoring for clinical trials. For a D&I study, a few issues are particularly important. Since many D&I studies occur in organizations whose employees are the study participants, it is important to describe potential costs and risks in participating by employees of the organization (e.g., will study participation affect one's job? What are risks associated with organizational change?). Dissemination and implementation research often requires considering the effect of interventions on diverse stakeholders (e.g., healthcare providers in addition to patients). In some cases, the participants might be involved in both receiving and delivering the intervention. This may result in data collection burden and direct involvement or knowledge of the intervention that may introduce response bias (see competency HS10 in *Table 1*).

### **Cross-Cutting Advice**

In addition to attention to the core competencies and section-by-section guidance noted above and elsewhere,<sup>16,43–47</sup> there are several considerations that relate to the grant development and submission processes.

### **Before you write your application**

It is important to understand the review process. This can involve understanding how grant applications are reviewed—this will vary by funding source and country in which the funding agency operates. There are detailed materials that describe the review process,<sup>48</sup> but the best way to learn about the review process is through serving as a reviewer. While senior researchers are frequently asked to serve on study sections, more junior scientist in the United States can join a review as an *ad hoc* member via the NIH Early Career Review Program.<sup>49</sup>

It is also critical for the applicant to read the program announcement carefully. This will help in finding the most appropriate funding mechanism. You will want to match the grant type to your project/aims. For the NIH, the K-series focuses on career development and the R-series covers investigator-initiated projects. Most often this is via the R01 but also includes the R03 (small grants), R21 (developmental research), and the R34 (clinical trials planning). It is worth noting that smaller grants are often easier to put together and may be easier to get funded. In Canada, both the Canadian Institutes for Health Research<sup>5</sup> and the Canadian Cancer Society<sup>6</sup> provide advice and instructions for applying for Knowledge to Action grants.

As you formulate plans, it is useful to discuss your idea with the Program Officer. The Program Officer is the person within the funding agency who will manage your grant. She/he can provide valuable early input in shaping your idea, suggest the best funding mechanism, provide advice on the most appropriate study section, and can be in the room (or on the telephone) when your grant application is reviewed.

When writing a major grant application, it is important to start early. It can take 3–4 months to put together a high quality grant application. If you are partnering with healthcare providers, health organizations, or other community partners, contacts with these stakeholders should be made, and partnerships should be built, months in advance of your deadline.

### During the application writing process

As you construct your grant application, it important to think like a reviewer.<sup>46,47</sup> Reviewers are busy people who will be able to dedicate a limited amount of time to each application. Most reviewers will make up their minds about an application fairly quickly. An effective grant application should be (1) easy to read, (2) concise, (3) attractive, and (4) tell a compelling story.<sup>44</sup> It is helpful to make effective use of tables and figures and to avoid page after page of dense text. You should write and rewrite multiple drafts, getting feedback from your colleagues along the way and making sure you have presented your best work. A sloppy application may imply that the Principal Investigator is a careless researcher.<sup>16</sup> As noted earlier, the aims page is particularly important for summarizing what you seek to accomplish on one page. Given the relative newness of the field of D&I research, the pool of highly qualified reviewers remains limited and many reviewers may not have expertise closely related to the subject of your application.

If you have one or two key points to get across (e.g., among the first studies addressing a particular topic or population), do not “bury the lead” by placing important information late in the grant application. It is useful to learn from how a journalist writes by highlighting key points up front and developing small chunks of texts that makes a narrative readable. Similarly, the title of your grant application matters; be sure your title is compelling and clearly summarizes the main focus of your proposed research.

As you pull together the pieces of your proposal, larger (e.g., NIH R01 scope) projects often need pilot studies to show feasibility of a larger D&I study. The pilot data might show key barriers for improving practice, ability to recruit sites/participants, testing of primary measures, or piloting an intervention. If this applies, be sure you have adequate pilot research that is described in sufficient detail. It can be helpful if the pilot data have been published or presented at a scientific meeting.

There are stringent rules from most funding agencies regarding what is allowable in appendices.<sup>50</sup> At the NIH, the appendices are largely limited to surveys, questionnaires, or other data collection instruments. Your grant application should stand alone—do not assume that assigned reviewers will read your appendix materials and do not include aspects of the science that are critical to review in the appendices. This may cause the grant to be rejected for not following the required format. Similarly, tables are not meant to be a strategy for circumventing the page limits, and should not contain extensive text lifted from the body of the grant and put into the smaller font allowed in tables.

When you have a draft D&I grant application ready, it is useful to find one or two external reviewers who will read and comment

on your grant application. Including draft reviewers who are not familiar with the contexts of your proposed D&I research can help you identify jargon or terms of reference that similarly naïve reviewers to whom your application could be assigned may have difficulty understanding. Your institution might also sponsor a grant “bootcamp” where senior D&I experts are available for a day to provide input on core components of a grant application. This concept has been applied successfully for writing scientific papers.<sup>43</sup>

When you submit your grant application to NIH, provide a cover letter that specifies the program announcement, the study section being requested, and specific types of expertise (but not specific people) needed to review your project.

### After your application is reviewed

The timing of when you learn how your application has been adjudicated through peer review, varies by research funding agency. For example, after your application has been reviewed at NIH, if it is discussed, a score will be posted within 3 business days and the full review comments (the Summary Statement) within 10 business days. Once you receive your NIH summary statement, you should talk with the Program Officer to obtain her/his advice on your chances for funding and whether there is a need to revise and resubmit the grant application. A key consideration regarding resubmission is whether the weaknesses noted in the Summary Statement are modifiable. If you decide not to resubmit your D&I application, you should talk with your collaborators about whether your idea might be repackaged for another funder.

### Conclusion

Preparing a strong D&I grant application is a rewarding experience and a skill fundamental to advancing our field by providing the foundation for high-quality research. Successful grant application writing is a skill that can be learned<sup>45</sup> and refined with experience and collaboration. While the funding environment is tight, following the principles we have outlined will enhance chances of success. Particularly for newer investigators, it is important to remember that the road to long-term success is paved with small setbacks.

### Acknowledgments

The authors are grateful to Ms. Nageen Mir and Drs. Matthew Kreuter, Chris Pfund, and Anne Sales who contributed to the card sorting and the initial development of this project.

Support for this work came from National Cancer Institute at the National Institutes of Health, through the project entitled: Mentored Training for Dissemination and Implementation Research in Cancer Program (MT-DIRC) (5R25CA171994-02). Additional support for came from National Cancer Institute at the National Institutes of Health (5R01CA160327); the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK Grant Number 1P30DK092950); and Washington University Institute of Clinical and Translational Sciences grant UL1 TR000448 and KL2 TR000450 from the National Center for Advancing Translational Sciences.

Dr. Stange’s time is supported in part by a Clinical Research Professorship from the American Cancer Society, as a Scholar of The Institute for Integrative Health, and through the Clinical and Translational Science Collaborative of Cleveland, UL1TR000439 from the National Center for Advancing Translational Sciences

component of the National Institutes of Health and NIH roadmap for Medical Research.

The contents of this paper are solely the responsibility of the authors and do not necessarily represent the official views of the NIH.

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