Chapter 14
Grant Writing

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Research grants provide the necessary means to successfully complete research projects. They are awarded to qualified individuals planning competitive projects and may significantly impact a surgeon's promotion and academic advancement. In this chapter, recommendations for a competitive grant application will be provided.

General Considerations

The search for a grant should begin with a project, a plan, and permission. Having a project in mind and identifying a suitable funding agency works generally better than the reverse (i.e. identifying a request for proposals and then creating a project). While several investigators will have their own research ideas upon which to base their grant proposal, a good approach to generate project ideas is to assess the needs of the applicant's field and brainstorm ideas with colleagues to identify important research questions needed to move

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the field forward. A good knowledge of the available literature on the topic that can be accomplished via a comprehensive literature review will help refine initial ideas and research questions. Developing a research plan and determining its feasibility is the immediate next step. Obtaining input early from a statistician to define the best methodological approach to the study is imperative to avoid headaches later. Considering the available institutional resources and personnel, the time commitment and effort required from the investigator, and the required funding will help determine the feasibility of the project. Applicants should consider their strengths and weaknesses and pursue strategic partnerships that will offer them necessary expertise when lacking. Identifying the individuals who will be needed to conduct the study and winning their buy-in and support may be important for the success of the project. Identifying a research mentor is perhaps the single most important factor for success. Experienced mentors can be an invaluable resource that can guide the applicant in every step of the process.

Becoming familiar with the institution's regulatory requirements and deadlines and obtaining necessary permissions (i.e. IRB or IACUC approvals, support letters, etc.) will make the process more seamless and minimize surprises. Determining an appropriate budget for the proposed work is of paramount importance to ensure the necessary resources will be available to successfully conduct the project once funded. Poor attention to the budget can threaten the feasibility of the study. Given that most applicants in their early career have limited understanding of research budgets, help from experienced personnel in the grants and contracts office should be pursued early.

During this process, the applicant should also identify the appropriate funding agency with an interest in the research topic. Early communications with responsible agency representatives will help determine if funding is available and whether the project is of interest to the agency. It is helpful to obtain prior successful applications for review, if available, to use as guides when putting the grant proposal together. Any potential institutional research funding opportunities should

be explored first. The competition for these seed grants is typically significantly lower than for external grants and thus the likelihood of success higher. Novice applicants will only gain valuable experience by pursuing such funding opportunities. Furthermore, pilot data are usually necessary when competing for larger external grants and can be obtained by using seed funding from the applicant's institution.

Once the potential funding opportunity has been identified, the applicant should carefully review the submission deadline and assess whether the available time frame is adequate.

Having a realistic picture of the time and effort required to prepare the application and to complete the project is imperative. In general, it takes about 1 year to collect pilot data, 1–2 months for IRB and/or IACUC approval, and 1–3 months to write the grant. The grant review may take 5–6 months from the submission deadline and up to 9 months to receive a funding decision.

Writing a Competitive Grant

First and foremost, the applicant should become familiar with the submission guidelines of the funding agency and observe them strictly. Not following these guidelines is an easy and almost guaranteed way to get your application rejected. While different funding agencies may use different application formats, grant sections typically required by most agencies are abstract/project summary, background and significance, preliminary work, hypothesis and specific aims, research design and methods, budget, assurances, available resources, and investigator curriculum vitae.

Abstract/Project Summary

This section describes succinctly every important aspect of the proposal with the exception of the budget and is usually limited to half or one page. It is a very important part of the

application as it is used in the grant referral process and may be the only aspect of the application that is reviewed by non-primary reviewers to understand the proposal. It should include a brief background, the specific aims or hypotheses, unique features of the project, methodology (action steps) to be used, expected results, evaluation methods, a description of how the results will affect other research areas, and the significance of the proposed research.

This section should be brief but complete, clear, and enticing. Use all the allotted space and write this section last to reflect the entire proposal. This section should be viewed as a one-page advertisement for the project. This gives the first impression to the reviewers and should be constructed very carefully. While you can't win the grant on the first page, you can lose it!

Background, Significance, and Rationale

The background and significance section supports why it is worth conducting and funding the proposal. This section should include the problem to be investigated, the rationale for the proposed research, a critical, focused literature review and identification of knowledge gaps, and how the results of the proposed study will fill those gaps. A compelling argument should be presented for the importance and necessity of the proposal, the strong points (innovation, new strategies, etc.) of the proposal should be stressed, and the broader applicability of the study findings highlighted. An in-depth understanding of the relevant existing literature is necessary to demonstrate expertise in the topic and support the need for the proposed work. Acknowledgement of the work of others in the field is important, as they may be reviewers of your application.

Preliminary Results/Pilot Work

This section affords applicants the opportunity to demonstrate their experience and competence in conducting research projects and establish the feasibility and importance

of the project. By describing the accumulated experience in the relevant topic, applicants demonstrate that they have the necessary skills to conduct the proposed project, and more importantly, that they can have confidence in their hypothesis. The critical preliminary findings that support the hypothesis and research design should therefore be included in this section. Prior successful, not directly related research work of the applicant can also help establish his/her competence. Lack of preliminary data will significantly weaken an application and its chances for funding. Given that accumulation of preliminary data can be very time-consuming, early planning is important.

Power Analysis/Sample Size Calculation

Power is the capability of a study to reliably detect any existing difference between study groups. Funding agencies recognize the risk of type II error with underpowered studies that may lead to wrong conclusions and threaten the validity of the study. A type II error occurs when a true difference exists between study populations, but there are insufficient numbers of subjects to detect this difference. Thus, by using a power analysis when designing studies, investigators can estimate the sample size needed to avoid erroneous interpretation of their results. Statistical support will help adequately address this section; importantly, sample size calculation may support or reject study feasibility early before too much effort has been invested in a particular project.

Hypothesis/Specific Aims

The purpose of this section is to provide a concise and realistic description of what the proposed research project is intended to accomplish. It begins with a description of the long-term goals of the study and states the hypothesis guiding the research. The hypothesis should be stated clearly, be testable, and adequately supported by the rationale and citations

provided in the background section. Two to four specific and time-phased research aims should be provided. The specific aims should directly target the hypothesis, be related, and not interdependent in order to avoid all failing if one fails. Focus on aims supported by your expertise and pilot data and avoid losing focus by including an unrealistic hypothesis or citing too many aims.

Research Design and Methods

This section is crucial for the success of a proposal and describes how the research will be carried out. It will be reviewed very carefully and should include an overview of the experimental design and a detailed description of the specific methods that will be used to accomplish the specific aims of the study. A detailed discussion of how the results will be collected, analyzed, and interpreted is also required. Reference to study limitations, and potential pitfalls, and how these will be overcome with any alternative approaches should be included to demonstrate the investigator's thoughtfulness and maturity. A justification of why the chosen methodological approach is preferable to alternatives is necessary as well as the inclusion of controls when appropriate. The methods should be described in sufficient detail and succinctly and an algorithm of the research design should be included to aid reviewers' understanding and ease of reading. Publications in support of the application (preferably authored by the applicant) should be cited. The engagement of collaborators who supplement the applicant's expertise is strongly suggested. Finally, the inclusion of a timetable demonstrates thoughtful planning and organization and supports the feasibility of the project.

Budget and Justification

This section lists and provides justification for all expenses required to successfully complete the project's aims. The usual components include key and other personnel, consultants,

equipment, supplies, travel, and other expenses. This is a very important aspect of the application and applicants should work closely with the institutional grants and contracts office when determining the budget. Having a good overview of the cost necessary to conduct the study will help the applicant decide which aspects of the proposal are feasible and which are not. A brief description of the duties for all proposed positions should be included, and the individuals for each position and their anticipated effort determined. In addition, a justification should be provided for equipment purchases and supply costs (detailed), project-related travel costs, and any included consultants or contractors. Being realistic and avoiding padding the budget or under-budgeting is important for the success of the proposal.

Assurances and Applicant Qualifications

Assurances are a necessary part of a grant proposal; they ensure that the applicant and institution will comply with all federal laws and regulations. It is best if Institutional Review Board and IACUC approvals are included in this section at the time of submission, but some agencies may allow the submission of these at a later time. A chairman's or appropriate institutional official's letter of support that guarantees protected time for the primary investigator and other key personnel during the study period is required. Letters of intent from collaborators should also be included. Demonstrating that the applicant can execute the proposed study and has adequate facilities and resources to complete the research is critical. The applicant should highlight his/her proposal-relevant contributions to the literature and achievements that support his/her role as a competent investigator. The reviewing process is very competitive and there will likely be several strong applicants in the pool. Therefore, this section needs to convey with facts that the applicant is the best possible individual to conduct the proposed study.

Overall Grantsmanship

Poor writing generally predisposes reviewers negatively to the proposed work. Therefore, the proposal should be succinct, visually stimulating, and easy to read and understand. Graphs and pictures should be used effectively to promote understanding. Avoiding jargon, spelling out acronyms, being consistent with terms, references, and writing style, and complying with the application's guidelines and format including adherence to the exact page allotment and specified type size are imperative. The application should be carefully proofread and checked for typos again and again. Have one or more colleagues who are knowledgeable and relevant to the field review your proposal prior to submission. The provided feedback will likely improve the proposal's clarity, and occasionally, may identify significant flaws the applicant may not have yet considered.

The Decision Is in: Now What?

If the decision letter is unfavorable, the applicant most likely will experience the five stages of grief (denial, anger, bargaining, depression, acceptance). Putting a grant together is a lot of work and having it be rejected leaves a very bad taste in your mouth. The last thing you should do, however, is give up. It takes time and dedication to get projects funded and, more often than not, the road to success is paved with failures. When you receive the rejection letter and critique, carefully review the reviewers' comments and determine if your design has any fatal flaws or is fixable. If the comments reflect enthusiasm about some aspects of the proposal and disappointment about others, it may mean that you are on the right path. The reviewers want typically to help applicants and will provide insight on how to improve the proposal, especially if they liked the idea but thought that the methodology was inadequate. If you think that the idea/research question is worth pursuing further after reviewing the comments, fix any

identified problems, revise your proposal according to the guidance provided by the reviewers and resubmit to the same or a different appropriate agency. Do not forget to check back with your collaborators and get their input on how to proceed before resubmission; you may have to add some new collaborators to enhance your collective expertise based on comments received. If the reviewer's comments reflect lack of enthusiasm about the study idea and the innovation of the proposal, you may need to go back to the drawing board together with your research team.

If the grant is awarded, then besides organizing a big celebration, the real work of implementing the proposal begins. How well all aspects of the proposal had been thought out and budgeted for up front will become clear during this implementation. The execution of the proposal takes significant time and effort that the PI needs to ensure will be committed for the successful completion of the study. Regular research team meetings that monitor the achievement of the project's milestones in a timely manner and the budget expenditures are imperative for success. Any significant changes or issues should be communicated to the funding agency early and regular project updates provided. Importantly, enjoy the process and celebrate the products of your research for which you worked so hard.

Tips for Success and Common Pitfalls to Avoid

Tips

- Find a research mentor early
- Avoid dense sections in the proposal that are difficult to comprehend
- Be clear, concise, and succinct; the grant should be easy to read; avoid language/grammatical errors
- Do not overpromise what you cannot deliver

- Have a clear and realistic plan for your project and how you will accomplish your proposed aims, including how you are going to measure your project's success
- Propose a feasible and appropriate experimental design
- Proposal has the potential to lead to further studies or funding
- Be persistent and determined to succeed
- Demonstrate your maturity as a researcher by identifying potential problems or barriers and propose ways to prevent or overcome them if they occur during your study
- Convince reviewers that your study is absolutely necessary for the common good, has strong potential to advance the field, and that you have assembled the ideal team to take on the proposed project
- Seek help with the writing and submission process (advice, help, and criticism by seasoned grant writers, researchers, proofreaders, grants and contracts officials, etc.); involve a statistician early
- Seek collaboration with other researchers that will supplement your expertise by helping assemble a strong research team that can handle all aspects of the proposal
- Plan early, know all submission deadlines, and have a clear submission timeline so that submission-associated stress can be minimized and errors avoided
- Identify the most appropriate funders for the project (due diligence); research internal opportunities
- Timely acquisition of required assurances and support letters
- Create a realistic budget; avoid over- and underbudgeting
- Include graphs, images, or study algorithms as necessary to improve readability of your proposal

Pitfalls

- Lack of innovation of the research question/proposal
- Unclear research question and methodology
- Study aims not aligned with the funding agency goals and objectives

- Study aims lacking specificity and not being linked to methods
- Inappropriate study design that cannot answer the research question or an untestable hypothesis
- Weak rationale for your proposal
- Lack of preliminary results
- Not including a power analysis/sample size calculation where needed
- Incomplete applications; not following proposal guidelines
- Poor grantsmanship
- Overambitious proposal that lacks feasibility
- Inadequate expertise of research team for proposed study; limited collaboration
- Failure to include all relevant literature on the topic; failure to give credit to the work of the most prominent researchers in the field (which can be your reviewers!)