

The art of obtaining grants

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Grant making is a multibillion-dollar-per-year business. The dollars involved are so large that if grant making were a single firm, it would rank near the top of the *Fortune 500* list.¹ This article describes the grantsmanship process from beginning to end, from the perspective of the investigator. It outlines strategies that can be used to maximize the chances of obtaining funding, suggests tools that can be used to identify funding opportunities, describes several sources of available funding, and offers guidance on writing and submitting grant proposals. Guidance is provided that can be used to manage grants and ensure compliance with the grant maker's requirements. Finally, suggestions are made to minimize the labor involved in preparing presentations and manuscripts, the ultimate grant maker's requirement that ensures its money has been wisely invested.

Strategies to maximize receipt of funding

Successful grant writing involves considerable preparation. Investigators must be knowledgeable of their own interests, expertise, and workplace environment; what research has already been conducted; and the

Purpose. The grantsmanship process is described from the perspective of the investigator.

Summary. Successful grant writing involves considerable preparation. There are thousands of grant-making agencies, both public and private, and many of the grants offered can be found in online databases. Investigators should focus their grant-seeking efforts on firms and research subjects of interest. Factors that determine the type of funding pursued include the source of funds, the activity pursued by the investigator, the research subject area, the geographic area, the investigator's career level, the investigator's affiliation with a professional society, and the size of the grant. To strategize for long-term success, there are two ways a new investigator can begin—by serving as a coinvestigator on a grant held by a more-senior investigator or by pursuing a small grant as a principal investigator. When reviewing grant proposals, reviewers usually focus on a proposal's significance and impact, originality, useful-

ness and generalizability, scope, approach to research, feasibility, and sufficiency of resources to complete the project. Once a grant is awarded, investigators must ensure they are well versed in conducting ethical research, complying with regulations of the Health Insurance Portability and Accountability Act, preparing human subjects applications, managing grant budgets, and managing the project and personnel. Most grant makers require the presentation and publication of project results.

Conclusion. Writing a grant proposal involves significant preparation. To be a successful grant writer, the investigator should have a strong interest in the research topic at hand. At the same time, he or she should have a clear understanding of the sponsor's perspective and interests.

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grant maker's interests. Months of thought often go into each of these aspects of preparation, as it takes time for ideas to mature, team members to be identified, and proposals to be solidified.

Ideally, grant proposals are written to explore the answers to research

questions in which the investigator is genuinely interested. Without a strong interest in the subject at hand, it would be difficult to sustain the effort necessary to carry a research project through to completion. Thus, the first step for grant seekers is to identify their own research inter-

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The Research Fundamentals section comprises a series of articles on important topics in pharmacy research. These include valid research design, appropriate data collection and analysis, application of research findings in practice, and publication of research results. Articles in this series have been solicited and reviewed by guest editors Lee Vermeulen, M.S., and Almut Winterstein, Ph.D.

ests. This soul-searching phase also requires investigators to conduct an adequate and accurate self-assessment of their professional strengths, expertise, and past experiences. Acknowledging these strengths allows grant seekers to assemble a team with the complementary expertise to engender the confidence of the grant maker and to complete the proposed project. Part of this self-assessment includes ensuring that the department has sufficient interest in and resources to support the proposed project. Finally, complete familiarity with the research area is necessary to identify the relevant research questions at the forefront of the field and understand how the proposed project will advance the field. Knowing oneself, the available resources, and the “state of the field” are necessary to justify to the grant maker that its dollars will be well spent.

After initial formulation of possible research questions, it is best to jot down initial project ideas. Writing a paragraph or two, both about the research question and the proposed methods for answering it, and outlining the available and needed resources are necessary steps. Only after these thoughts have been committed to writing should the ideas be shared with colleagues.

Grant makers are motivated by specific goals that reflect the concerns of the organizations they represent. It is fundamental that grant seekers align their interests with those of the grant maker. Grant makers are interested in funding projects that bridge gaps in existing knowledge. Too of-

ten, grant writers focus on their need for funding instead of matching their need with the sponsor’s priorities. To pique the interest of the grant maker, each proposal must be tailored to the needs of the grant maker. In some ways, being a grant writer is like being in business for yourself, in that it involves selling your ideas and expertise to others. The next step is to identify grant makers whose priorities are similar to your interests.

To determine how closely aligned one’s project ideas are with those of potential funding agencies, it is wise to review a list of projects those agencies have recently funded. For private foundations, this list is often posted on the grant maker’s website. Projects funded by agencies that are part of the Department of Health and Human Services appear in a federally sponsored database, the Computer Retrieval of Information on Scientific Projects (CRISP).² CRISP is useful for identifying existing projects, collaborators, and competitors. Another widely used tool is offered by the Community of Science (COS).³ COS is a leading provider of information resources to researchers, scholars, and professionals around the globe.⁴ COS provides a platform that serves over 1600 universities, corporations, and government agencies worldwide and provides services that enable professionals to find funding, people, and information important to the scientific endeavor. The COS Database of Funded Research enables the tracking of funding histories from leading agencies around the world.³ Contacting the grant officer at the funding agency is also recommended. An important aspect of grant officers’ jobs is to discuss research ideas with potential investigators. Gauging their enthusiasm and soliciting their advice about how to frame a project can help determine whether a project will be funded.

Identifying grant opportunities

There are thousands of grant-

making agencies, both public and private. A successful investigator continuously scans the “research horizon” for funding opportunities. Learning how to do this is the most difficult part of this phase; however, once learned, keeping a vigilant eye on upcoming funding opportunities becomes easier.

It is often helpful to begin with a broad search for funding, as this helps grant seekers understand the breadth of a field. Narrowing a search from there can facilitate a greater understanding of the placement of one’s work in the entire field. Two companies with Web-based databases—COS⁵ and GrantSelect⁶—provide a comprehensive list of funding opportunities, both federal and nonfederal. COS Funding Opportunities is the largest compendium of information about available funding, consisting of over 22,000 records and 400,000 funding opportunities worth over \$33 billion.⁵ Investigators can create an individual profile outlining their areas of expertise and research interests and can receive a weekly e-mail notification of a customized list of funding opportunities based on keywords and criteria provided by the member.⁷ Individual membership is free, and registration is simple. GrantSelect provides a list of over 10,000 public and private funding opportunities and requires a membership fee.⁶ University memberships are available for both databases.

Private foundations. Private grants come from foundations and corporations.¹ There are over 43,000 private foundations in the United States, offering over \$8 billion in research funding annually. To maintain their tax-exempt status, foundations must distribute at least 5% of their market value in assets or interest income annually, which motivates them to fund research that furthers their missions. The websites of two major organizations—the Foundation Center⁸ and the Council on Foundations⁹—have links to such

foundations. Corporations, on the other hand, are for-profit entities and provide grants to further the business at hand. In contrast to the more-formal grant application processes and timelines followed by government agencies and private foundations, the opportunity to obtain a corporate grant often arises as an unstructured opportunity and hinges on personal contacts, networking, and the ability to sell an idea.

There are several pharmacy foundations that provide support for pharmacists in training, in early career development, and in practice-based research (Table 1). The American Society of Health-System Pharmacists (ASHP) Research and Education Foundation offers a junior investigator award and a practice-based research award for pharmacy residents, as well as other types of awards.¹⁰ The ASHP Research and Education Foundation also sponsors a “research boot camp,” a research-skills-development training program. The American College of Clinical Pharmacy Research Institute offers awards for new investigators and for pharmacists pursuing further career development.¹¹ The American Association of Colleges of Pharmacy offers a new investigator award for pharmacy faculty,¹² while the American Foundation for Pharmaceutical Education offers several awards to undergraduate and graduate pharmacy students pursuing research careers and advanced research training.¹³ The Pharmaceutical Research and Manufacturers Association Foundation offers starter grants in several areas of study.¹⁴ Additional information about eligibility and application deadlines is also available from the websites of each of these foundations.

Pharmaceutical industry. Many pharmaceutical companies will consider funding small studies from their limited project budgets. These are best identified by establishing networking ties with industry-

Table 1. Funding Sources for Pharmacist Investigators

Grant Maker	Grant Name or Description
American Society of Health-System Pharmacists Research and Education Foundation ¹⁰	New investigator grant programs <ul style="list-style-type: none"> • Federal Services Junior Investigator Research Award • Junior Investigator Research Award • Pharmacy Resident Practice-based Research Award Medication Safety Team Grant Research Boot Camp Hospital Pharmacist–Hospitalist Collaboration in Improving Glycemic Control
American College of Clinical Pharmacy Research Institute ¹¹	Investigator Development Research Award Frontiers Career Development Research Award
American Association of Colleges of Pharmacy ¹²	New Investigators Program for Pharmacy Faculty
American Foundation for Pharmaceutical Education ¹³	Pharm.D. and undergraduate “Gateway to Research” scholarships First-year graduate school scholarships
Pharmaceutical Manufacturers Association Foundation ¹⁴	Research starter grants in <ul style="list-style-type: none"> • Health outcomes • Informatics • Pharmacology and toxicology • Pharmaceuticals

employed colleagues at the local and regional levels and, of course, finding a study that is of interest to both the investigator and the firm. Although funds from these sources are not as readily available as they once were, several divisions in these companies have educational grants in their annual budgets. It is worth checking with managed care liaisons, medical sciences liaisons, and regional account managers, even from the same firm, as the budget for each area is often separate.

Federal funding opportunities. Sources of federal funding are listed on several websites, the most useful of which are those of the Office of Extramural Research of the National Institutes of Health (NIH)¹⁵ and the National Science Foundation.¹⁶ Each of these websites offers a plethora of information about the agency and its priorities, and it is well worth the time spent to familiarize oneself with these resources if

embarking on a research career. Additional sources of federal funding opportunities are listed on the websites of the Department of Defense (e.g., Air Force,¹⁷ Army¹⁸) and the Department of Health and Human Services (e.g., Agency for Healthcare Research and Quality [AHRQ],¹⁹ Centers for Disease Control and Prevention,²⁰ Health Resources and Services Administration²¹).

Staying abreast of the grant-making landscape

Investigators should focus their grant-seeking efforts on firms and research subjects of interest. Registering to receive a weekly e-mail from any interested agencies can greatly streamline the requirement to stay current in the grant-seeking business. In addition, once an investigator becomes familiar with firms of interest, a periodic visit to the firm’s website is warranted. Experienced grant seekers are often familiar with

the funding cycles of federal and private funding agencies of interest and intermittently check the websites of these organizations. Universities often have specific resources devoted to assisting faculty and health professionals in obtaining research funding. These resources can include assistance with database searches and information about funding alerts, grant-writing workshops, and educational sessions about obtaining and managing grant funds. Grant seekers practicing in a university setting should consider using these valuable resources. Universities often serve as grant makers as well.

Sources of funding

Grants come in all shapes and sizes, and there are several ways to decide on the type of funding to pursue. By categorizing funding opportunities, an investigator can develop a strategy that maximizes success. Factors that determine the type of funding pursued include (1) the source of funds (e.g., federal, private, corporate), (2) the activity pursued by the investigator (e.g., conference, specific project, program infrastructure), (3) the research subject area (e.g., diabetes research funded by The American Diabetes Association Research Foundation²²), (4) the geographic area (e.g., The Seattle Foundation, found through the Grantsmanship Center²³), (5) the investigator's career level (e.g., junior versus senior investigator grants), (6) the investigator's affiliation with a specific professional society (e.g., ASHP Research and Education Foundation¹⁰), and (7) the size of the grant. These factors are not mutually exclusive, and several will apply for any given grant.

Federal grants offered through NIH and AHRQ are categorized by a "mechanism," a term used to describe the intended scope, size, eligibility, and funding commitments of the grant. Training grants from these agencies are sometimes awarded to institutions rather than to individual

investigators,²⁴ and pharmacists and pharmacy students are eligible to apply. A popular traineeship is the T32, which is intended to develop clinical researchers ranging in experience from prelicensure to postdoctoral levels. The F31 and F32 provide predoctoral and postdoctoral funding, respectively.²⁵ The K-series is a set of career-development awards that supports investigators who are developing careers as independent investigators.²⁶ T32 and K12 grants are held by the academic institution; F31, F32, and K08 grants are held by individual trainees. Application for these grants is made with an investigator's institution or directly from the federal government, respectively. NIH and AHRQ also offer several types of full investigator awards—small grants (R03), exploratory and developmental grants (R21), and independent research project grants (R01).²⁷

In addition to a grant's mechanism, each grant opportunity is identified as either a program announcement (PA) or a request for application (RFA). PAs remain open for an extended period of time and are structured to attract independent investigators to apply for funding in a broadly defined area, the details of which are left to the investigator to propose. RFAs are used to announce one-time opportunities and intended to motivate applicants to study a specific area outlined in the RFA. Not all NIH institutes and centers offer the same grant opportunities, so knowing the institute or center funding a specific opportunity is also important.

Pharmacists possess a unique knowledge base that assists them in conducting clinical, translational, and health services research. Despite this training, few pharmacist investigators receive competitive federal research funding. Schools of pharmacy collectively receive less than 1% of NIH's budget for extramural research.²⁸ To address this disparity, NIH sponsored a landmark confer-

ence in December 2006. Attendees at this conference discussed ways to increase the research skills of pharmacy school graduates so that they can become competitive investigators. A summary of the conference proceedings is posted on an NIH Web page titled "Pharm.D. Gateway to NIH."²⁸ This website also provides more detail on several funding opportunities for pharmacists, many of which are mentioned above. This conference and website herald a new era in the recognition of pharmacist investigators as potential research scientists.

Which strategy? Coinvestigator versus principal investigator

To strategize for long-term success, there are two ways a new investigator can begin—by serving as a coinvestigator on a grant held by a more-senior investigator or by pursuing a small grant as a principal investigator. There are advantages to each. Becoming a coinvestigator on an existing grant provides an opportunity to learn how to conduct research from qualified mentors, without the stress of ultimate project responsibility. Alternatively, seeking seed money for one's own project can provide the full experience of project responsibility on a small scale. Foundations that are associated with professional pharmacy organizations have an additional incentive, as they are invested in the career development of pharmacists, and provide seed money to support young investigators working under the mentorship of more-senior colleagues. From the grant maker's perspective, providing seed money in small grants minimizes its risk of investing in an investigator who is just beginning to build a track record. From the investigator's perspective, seed money provides funding to conduct a pilot project, the results of which can demonstrate the need for a larger study, while simultaneously proving that the investigator has the tenacity to complete a project. Most major grants require the submission

of pilot data in the grant proposal, and the best way to obtain these data is often through the seed money provided by a starter grant.

Writing and submitting grant proposals

The format and length of a grant proposal are dictated by the funding agency. Proposals submitted to private foundations are short (usually a few pages) and focus on describing the problem and proposed solution. Proposals submitted to federal agencies can include up to 25 pages of text for the research plan,²⁹ plus supporting documents. Reviewing one or more proposals previously submitted by a colleague can be extremely helpful in learning how to write one. In all cases, follow the instructions of the grant maker, paying close attention to every detail outlined. Proposals can be returned without review if guidelines are not closely followed, and reviewers look more favorably upon a proposal written in the required format. Attention must also be focused on the appearance of the proposal. The use of suggested fonts, sufficient white space, headers, bold type, ragged right margins, and bulleted lists all make for easy reading and facilitate a positive response from reviewers. A succinct writing style, well-formulated hypotheses, evidence of past productivity, and knowledge of proposed analytic techniques, as well as good grammar and correct spelling, are essential. Miner and Miner³⁰ authored a very useful guide on the details of writing a proposal. Finally, if grant makers' instructions are not clear, their office staff are often helpful in offering guidance before the grant deadline.

A successful grant application is an exercise in communication, and it is incumbent on investigators to communicate their ideas clearly. Even with short proposals, the use of an outline can improve clarity. The standard outline, based on an NIH template,²⁹ includes a cover letter,

either from the investigator or an institutional official; an abstract; a list of project-specific aims; the background and context for the research, including a description of the gap the proposed research is intended to fill; the significance of the work; and a summary of preliminary data. The outline is followed by the research plan and a section describing how the project will adhere to the principles of ethical research practice for human subjects. Other required components include references, budgets and budget justifications, a description of the research environment, and a biographical sketch for each investigator. Appendixes include letters of support from collaborators, templates of data-collection tools, and investigator-published articles related to the same research area. Often, space is reserved to describe the credibility of the organization and the investigators, sometimes serving as an introduction to frame the proposal.

The research plan begins with a reiteration and more-complete description of each specific aim. Sufficient detail should be included at this point so that reviewers can see how the outcome will be measured. For example, rather than stating, "We will evaluate the impact of electronic prescribing on medication errors in the ambulatory care environment," the research plan should state, "By reviewing 10,000 prescriptions from three family practice clinics, we will determine the impact of electronic prescribing on medication errors, as identified using the taxonomy established by the National Coordinating Council on Medication Error Reporting and Prevention³¹; we will consider a reduction in the error rate of 25% to be significant." Following this are definitions of the dependent variable (outcome) and the independent variable (explanatory) and descriptions of the data sources, inclusion and exclusion criteria, evaluation methods, data management,

data analysis (to include a power calculation if applicable), potential challenges and alternative plans, dissemination plans, and limitations. A timeline, coupled with a task list, should also be included. Dissemination plans are an important component, as they help grant makers envision the return on their investment. Investigators should be as specific as possible about the meetings at which preliminary results will be presented and about the journals targeted for manuscript publication. A word of caution: Never submit a grant that has not "matured"; if it has not undergone sufficient internal review and revision, do not submit it. Wait until the next opportunity. Submitting a proposal that is not polished will diminish credibility and reduce future chances of success.

Budgets are often very specific and include salaries for personnel, equipment, supplies, travel to the field site, travel to meetings to present results, and educational support, as allowed. Each aspect of the budget must be sufficiently justified to ensure accountability to the grant maker; time frames must be included. Justifying the proportion and duration of each individual's time is critical. It is appropriate to obtain a firm commitment from coinvestigators at this juncture to prevent misunderstandings about time commitments after the award has been made. Costs usually include those used to directly support the project, as listed above (direct costs), and those that will be charged to institutional overhead (indirect costs). More complex budget processes may include subcontracts with an outside entity or cost sharing with a collaborating institution. To be competitive, always stay within the budget constraints proposed by the grant maker.

Depending on the length of the proposal, complexity of the research, and experience of the investigator, a grant proposal may take one to six months to write. Writing the

research plan is only half the task. The remaining tasks also take considerable time—preparing budgets, assembling supporting documents, and submitting material online. It is best to involve coinvestigators and administrators from the outset. Coinvestigators can assist with the development of the research plan and revise and improve drafts of the plan, while administrators can assist with budget preparation, document assembling, obtaining institutional approval (which can take up to two weeks), and electronic submission. Newly launched online submission requirements^{32,33} require advance registration and have a learning curve that requires familiarization before the final uploading of documents. Do not get discouraged; grant writing usually becomes easier with experience, and one proposal can leverage the next.

Grant review

Sometimes the grant maker will ask for a letter of intent, a one-page summary of the overall project idea, research aims, and personnel. This letter assists the grant maker in convening a panel of reviewers whose expertise will be aligned with the proposal submitted. The reviewers evaluate each proposal using predefined criteria (announced in the request for proposals). Reviewers usually focus on the following areas when reviewing grant proposals: (1) significance and impact, (2) originality, (3) usefulness and generalizability, (4) scope, (5) approach to research, (6) feasibility (expertise and experience of the research team), and (7) sufficiency of resources to complete the project. The review can take three to six months.

The waiting period is difficult but should be a time of planning. Plan for both funding and rejection, as this will provide options for the future. If funded, what will it take to launch the project? If rejected, are revision and resubmission al-

lowed or encouraged? If not, would a different grant maker be interested in a similar proposal? After thinking through these questions, it is best to move on to other projects and activities while waiting. In the interim, it is acceptable to submit the proposal to a different sponsor; however, if both proposals are funded, each budget must cover different aspects of the work or the scope of work must be increased to prevent overlap.

Decisions are usually returned with comments that are usually useful for revising and resubmitting to the same (if allowed) or a different grant maker. If it is the grant maker's policy, it is sometimes acceptable to call the grant maker to have a debriefing. This conversation will sometimes provide information that does not come through on paper, such as the grant maker's enthusiasm for the project. There is no reason to resubmit if the response was lukewarm, unless the grant maker's concerns can be substantially addressed in a subsequent version. More than one resubmission is not recommended and not often allowed. If not successful at this juncture, it may be time to move on to another idea. No investigator receives funding for all grants submitted. Take comments constructively, and revise and resubmit your proposal, but beware of the law of diminishing returns.

Grants management

Being awarded a grant presents a different set of challenges. Being a principal investigator means having responsibility for all aspects of grants management: ensuring scientific rigor of the research project at hand, performing accurate data collection and correct analysis, preparing and delivering presentations, and drafting and submitting manuscripts—all duties normally of interest to scientists. But the principal investigator must also be well versed in (1) conducting ethical research,³⁴ (2) complying with

regulations of the Health Insurance Portability and Accountability Act (HIPAA),³⁵ (3) preparing human subjects applications, (4) managing grant budgets, and (5) managing the project and personnel. Gaining familiarity with these aspects of research while awaiting the results of the funding decision is time well spent.

Principal investigators must have personally received training in the ethical conduct of research with human subjects and must ensure that all key personnel on the research team have done the same.³⁴ Although these requirements are for holders of grants sponsored by the Department of Health and Human Services, most research institutions have adopted similar requirements for investigators holding grants from other grant makers. Many institutions have developed their own educational programs that meet this requirement or contracted with an institution that does. It is also incumbent on the investigator to become certified as a researcher familiar with HIPAA regulations.³⁵ Excellent resources on the ethical conduct of research can be found on the website of the NIH Office of Human Research Protections³⁶; information about HIPAA regulations is available from the NIH website for HIPAA resources.³⁷ Approval from the local investigational review board to conduct research is required for each research project involving humans. Completing these applications seems onerous at first, but expertise in completing them efficiently is gained over time.

The principal investigator is responsible for all fiscal aspects of the project, for hiring and overseeing the work of project personnel, and for all project management tasks. Most grant makers require periodic status reports on grants they have funded, including both a description of the scientific progress and a budget update. To assist investigators with this myriad of duties, most research

institutions offer training programs in the ethical conduct of research in humans, compliance with HIPAA regulations, and budget management. New investigators should make use of these resources.

Manuscript preparation

Most grant makers require the presentation and publication of project results. Although guidance about how to draft a manuscript is not within the scope of this report, a short description of the overlap between grant and manuscript writing is. A grant proposal requires many of the same components as a manuscript. The one-paragraph project overview from the proposal can begin the abstract of a manuscript. The literature review that formed the background section of the proposal can be used to create the introduction and discussion sections of the manuscript. The research plan and human subjects application can serve as the methods section. The poster or podium presentations of initial results (complete with peer feedback obtained in these venues) can form the results section. Much of the manuscript is often completed before the manuscript-writing process actually begins. Authors should also acknowledge the sponsor in poster and podium presentations and manuscripts.

Another strategy to facilitate manuscript writing is the “three-paragraph rule” (i.e., write no more than three paragraphs per section). The introduction should contain the background and end with the project objectives. The methods and results sections should be limited to three paragraphs each. The discussion section should recapitulate the results, compare the results to those of other investigators, and end with study limitations. A one-paragraph conclusion and a one-paragraph abstract are written last. The first draft is the most difficult to write. Authors should strive for brevity and clarity,

select an appropriate journal, and then submit their manuscript.

Conclusion

Writing a grant proposal involves significant preparation. To be a successful grant writer, the investigator should have a strong interest in the research topic at hand. At the same time, he or she should have a clear understanding of the sponsor’s perspective and interests.

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