Writing Successful Grant Applications for Preclinical Studies*

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The ability to write successful grant applications is critical to success in academic medicine. This information is based on many years of experience at both ends of the process: writing and reviewing.

Main Points and Explication

The most common source of funding for grant proposals in the field of biology in the United States is the National Institutes of Health (NIH). The Department of Defense, National Science Foundation, and many local agencies are utilized by many investigators. An insight into the NIH guidelines and procedures is provided by an NIH Web site: http://grants.nih.gov/grants/grant_tips.htm.

Based on my many years of preparing and evaluating proposals for the National Cancer Institute, American Cancer Society, and Veterans' Administration, I can offer a few suggestions that may make the process more approachable. The NIH is a relatively transparent system. Proposals go to the Center for Scientific Review, and the names of the various study

sections and their membership are available at: http://www.csr.nih.gov/Roster_proto/sectionI.asp. The prospective grant writer can see where a proposal is likely to go and who will be reviewing it. It is certainly legal to write a covering letter suggesting a study section, but this will not necessarily be followed.

Membership of other review groups is not necessarily made public, but some perseverance may yield results. The major goal here is to have the option of tailoring the proposal to the (likely) reviewers. Do not forget to refer to work done by members of the target study section in the proposal. It is also very helpful to get a few critics to look over a proposal before it is submitted. Often, a new set of eyes will pick up mistakes and assist in clarification of issues. It has been said, with some justification, that the grants review process is an adversarial process. The reviewers will initially be looking for justification to criticize a proposal. Only if nothing obvious is found will the review turn out to be favorable.

At the present time, the pay line for the NIH is in the vicinity of 11%. The procedure is for the bottom 50% to be identified, and not actually discussed at study section meetings. This saves time for the proposals in the top 50% that stand some chance of being awarded. This decision is made by the two or three reviewers to whom each grant is initially assigned. It takes a unanimous vote of the study section to "triage" a proposal. Otherwise, the proposals are presented by the assigned reviewers and discussed by the entire panel. This process is also generally followed by other review groups.

In order to get a proposal favorably considered, it needs to have a rationale, enough preliminary data to convince reviewers that the work can be accomplished, and evidence that the techniques to be used are feasible and can readily be carried out. It is not a good idea to propose that some expensive piece of equipment is needed and that the operator will read the instruction manual to learn how to use it.

The reviewers will be looking at the expertise and publications record of the applicant, along with those

of coinvestigators or those who agree to provide advice. Remember to obtain letters from everyone who agrees to help out, indicating that they are aware of this commitment. Sources of any specialized reagents or equipment need to be indicated. It is also important to ensure that the proposal is well organized with no obvious repetitions, misspelled words, mixed-up figure captions, or other trivial mistakes. The specific aims need to be indicated, along with some idea of how these were chosen and how they will be dealt with.

It is important to have figures, tables, and charts of sufficient size and clarity so that they can easily be digested. It is also useful to remember what the reviewers are going to be looking for: significance, importance of the question being asked, whether a successful result will produce useful knowledge, and indications that the applicant knows how to get the work done. Badly designed proposals, errors in interpretation of data, lack of preliminary results, and of clarity suggest that the applicant is not well organized and is not likely to be able to get the work done. Check to see that the references are correctly numbered. If, for example, a reviewer finds that the reference numbers in the bibliography have somehow gotten out of order, this will not make a good impression.

When an ongoing grant is up for renewal, reviewers will want to see evidence that something has been accomplished during the previous period of support. This generally means several publications in nontrivial journals, and a concise statement of how each previous goal was dealt with. A common reason for turning down competing renewals is lack of progress.

The rules state that new investigators (as defined by the granting agency) are not expected to have much preliminary data since they will likely not have had the funds needed to obtain a substantial amount of data. This rule has not always been observed by study sections, but there is now a format for putting some money into a pot specifically designed for new people. It is still a good idea to put in as much preliminary data as can be accumulated. It does help.

The NIH now has a new process called the ERA (Electronic Research Administration) Commons, in which a proposal and its fate appear online. Each investigator is asked to create an account and password where the proposal and its progress through the system can be followed. The scoring by the study section will appear within a few days after the review. It is important that the applicant sign onto this system and look over the proposal as soon as it reaches the ERA Commons website. This will show the proposal as scanned into the CD-ROMs that will be distributed to each member of the study section. If pages 10 and 12 have somehow been lost or mixed up, this is the time to bring it to the attention of someone at the NIH. Soon all proposals will be entered electronically, and no paper will be mailed. This should aid in ensuring that the reviewers are viewing what was sent in.

The NIH budget process has allegedly been simplified, with requests of $\leq$ \$250,000/yr submitted in \$25,000 increments. Only the total budget and the personnel are indicated, so the study section will not be discussing whether an applicant really needs a pH meter, two incubators, and a centrifuge rotor. Of course, each institution still requires a detailed budget, so not much time is saved by this approach. Larger proposals do require itemizing.

Assuming that an applicant has followed the guidelines, asked a few critics to read over the proposal, and sent it in before the deadline, let us follow in some detail what happens next. The proposal will be assigned by the study section administrator to two or three reviewers who will decide whether this is likely to be in the upper 50% of all proposals. If so, the reviewers present a level of enthusiasm (outstanding, excellent, good, fair, or poor) to the study section. Then each reviewer presents a commentary, and the proposal is discussed by the entire group. The scores range from 1.0 (absolutely outstanding) to 5.0 (totally worthless). Since only the top 50% of proposals will be discussed, the lowest score should theoretically be 3.0, but sometimes a reviewer thinks a given proposal really is in the lower half, and a score > 3 will be given. The Chair of the study section then announces the permissible voting range. If one review suggests a rank of 1.9 and another suggests 2.2, anyone on the panel can vote for any score, but someone who votes for a widely divergent rank, *eg*, 3.9 or 1.1, is obliged to write a brief note justifying that score.

The budget is then discussed and may be recommended for changes (this usually means a decrease). The applicant will get both the score and the percentile rank within a few days. The latter is calculated on the basis of all scores in that particular study section. If 100 proposals are ranked and yours is the best, it is in the first percentile (1.0). This is not the end of the story: the program people then have to approve the project and the budget will be adjusted. These days, there are cuts imposed of the order of 29% for new grants. So if you ask for \$200,000/yr and the study section recommends \$200,000/yr, the final award could be for \$142,000.

It is always dismaying to miss the pay line, but especially so if the line is drawn at the 11.1 percentile and your proposal comes in at 11.5 or 12. The NIH program officials have the option of supporting a proposal that misses the pay line if it is considered to have some special features deserving of an exception. Don't count on it.

Whether or not a proposal is awarded, within 6 to 8 weeks the ERA Commons Web site will receive the review sheets from the reviewers. Proposals that fall into the triage range will not receive a score, but every proposal gets reviewed. These can be of substantial assistance in preparing a revision. The NIH permits two revisions for each proposal, *ie*, each proposal can come back twice. It is important in preparing a revision to profusely thank the study section for their valuable criticism, and indicate what new preliminary data and revised goals answer these concerns. It is generally not a good idea to point out that the prior review was absurd, poorly done, idiotic, missed the point, and/or total rubbish. This does not help, even if true. It is also important to remember that the same reviewers may not get the proposal again. Membership on each study section is for only 4 years, and some reviewers are *ad hoc*, *ie*, invited for only one session for their special expertise. A new group of reviewers may find other items to be concerned about.

Take-Home Messages

It is important to do the following: (1) check out the Web sites provided by the NIH or other granting agencies for helpful hints; (2) when feasible, try to tailor your proposal to the (likely) reviewers; (3) have your proposal reviewed and criticized before it goes out; and (4) be sure it tells an interesting story. It is of great help, should the opportunity arise, to serve on a study section or grants panel so as to see how the review process is done. Don't miss the opportunity. It is a good bit of work but well worth the effort.