Department of Medicine Primer:

Grantsmanship 101

by

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Preface

The advice in this guide will be most directly helpful in preparation of an individual research grant that proposes lab-based research, for submission to the National Institutes of Health. However, the principles outlined here are applicable to construction of all funding applications. In addition to carefully following these guidelines, you are encouraged to scrutinize examples of successful grant applications to gain additional insight into the "feel" of a fundable grant.

Some aspects of this guide might generate varied opinions, but most of the advice contained herein would be offered by everyone with a successful track record of NIH funding. While there is a lot of detail here, it is all important. It is recommended that you consider all the points carefully as part of the grant preparation process.
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The bottom line

#1
Be clear about your goal:

Your goal is not to "write a grant"

It is to craft an application that cannot be criticized

#2
The most important part of a grant application is:

the research idea itself

#3
A successful grant application will fulfill four criteria:

1] it proposes work that can be done by the applicant

2] it is error free and easily understood by a reviewer

3] it is hypothesis driven

4] the work you propose definitively tests a novel idea, or it applies a new approach to testing a problem that is acknowledged as being important in the field
Grant-writing Fundamentals

• Leave plenty of time

A grant submission must be a perfectly crafted work of art. This cannot be done well if it is left to the last minute. The author allows three months for preparation of a grant (even after 25 years of grant preparation experience). And do remember that to process your application, the institutional bureaucracy will need your grant ahead of the submission deadline. Don't unnecessarily flirt with fate by submitting your grant at the last minute.

• Successful grant preparation has as much to do with thinking as with writing

After you know the field and have a viable idea and preliminary data, then take a month for detailed contemplation and outlining the grant. This assumes a process of continuous revision and filling out of the outline. Then allow a month (at least) for the actual document writing. Then allow a week to get the budget and ancillary forms done. This leaves about three weeks until grant deadline, sufficient time to critically review your own proposal and attend to last minute changes.

• Get an outside opinion

You may find it useful to have an expert critique your work. Remember, though, that this is asking a lot. Asking someone to "read your grant" won't be of much help unless they really critique it in detail as an NIH reviewer will. If you can find someone who will specifically agree to do this arduous task, fine, but add a month to your planned preparation time for it. In fact, most people you ask to do this won't fulfill your need.

In any case, it will be useful to you to seek input before you start writing. Discuss, preferably face-to-face, your hypothesis and approach in detail with an expert (or two) in the field.
Characteristics of a successful grant

Style
• carefully crafted
• clear and concise
• error free
• well written, easily readable, enjoyable to read

Topic
• focused, not diffuse
• appropriate for mission of the funding agency

Background
• thoroughly referenced
• presented in an unbiased and rigorous manner
• clearly indicates that the applicant is knowledgeable in the field
• conveys why the proposal is an important one
• illustrates the link between known data and the hypothesis

Research question
• clearly-defined
• important, ie is the right one (for the topic, for the era)
• the idea is novel (or the approach to the idea is novel)
• is framed as a hypothesis

Proposed experiments
• comprise a logical plan
• directly address the stated aims
• are doable by the applicant
• are designed to definitively and critically test the hypothesis
• don't leave important unanswered questions
• can be performed in the proposed time frame
• include a description of anticipated problems and contingency plans
• are neither over-ambitious nor under-ambitious

Methods
• are appropriate (modern, best ones to achieve experimental goals)
• are well established by others, or are validated by applicant

Experimental design
• is the most efficient, informative, definitive approach possible

Expected results
• are described
• directly address the study aims and hypothesis
• do not leave important "loose ends” unanswered
Anticipated Problems
• are delineated, with solutions proposed
The best things you can do

1. Write your application as a reviewer, not as an applicant.

2. Make the application error free and easily readable.

3. Catch the reviewer's attention and interest at the outset.

4. State your goals, aims, plans in terms of testable hypotheses.

5. Craft a background section that provides clear rationale for your proposal.


7. Be focused on an exciting idea/hypothesis.

8. Be sure you have expert level knowledge of the subject area.

9. Make no assumptions about the reviewer's level of knowledge.

10. Propose to test your hypothesis, not just to support it.
The worst things you can do

1. Write a grant at the last minute or without adequate preparation.

2. Mis-represent the existing literature.

3. Show preliminary data that don't support your interpretation or hypothesis.

4. Fail to convincingly convey why your idea is important.

5. Fail to provide convincing evidence that you can do the proposed work.

6. Write a sloppy application, with spelling errors, internal inconsistencies, etc.

7. Be diffuse or unfocused.

8. Fail to be crystal-clear yet concise.

9. Fail to propose truly definitive experiments.

10. Propose to do too much or too little
Picking a topic

"How do I know my idea is a good one?"

The ability to answer this question is best derived from your own expert-level knowledge of the subject area, although discussions with others in the area will be helpful. This should be done as part of the 'leg-work' that is done prior to actual writing.

Rules of thumb in selecting a topic

• Be focused, not diffuse.

You must propose to definitively address a topic, so failure to be focused is a major hazard. A little progress on a lot of things is not an acceptable goal. Therefore, the research problem needs to be definable and have limits.

• If it isn't worth doing, then it isn't worth doing well.

The questions asked should be important ones, questions that anyone in related areas would recognize as being important. [This does not mean that they'd come up with the idea themselves; it means that they'd recognize its importance if they knew the Background information as well as you do.]

• Go for impact.

The answers you anticipate finding should be expected to have an impact on the field. They should create new hypotheses, new lines of investigation, provide new insights that are valuable.

• Sex appeal.

Some worthy research ideas will go unfunded because they don't intrigue and tantalize the reviewers. Thus, an excellent grant that addresses a "boring" topic could go unfunded. This means focusing on a topic that falls within the spectrum of current interest in your field. An exception to this: if your idea is sufficiently novel to generate its own interest.
Style and format

• Follow instructions
  Follow all agency application instructions meticulously.

• Big type
  Reviewers wear bifocals. Use a simple, large font.

• Be succinct
  Shorter is better, as long as the presentation is complete. There is no advantage
to using up every allotted page.

• Readability
  Figures, legends and tables must be easily readable, including on xeroxed copies of the application. Put original figures/prints in each grant copy. [On xeroxed gels, eg, bands tend to become smudges or smears; the reviewer will believe what he/she sees, not what the applicant claims a figure shows.]

  If Figures are in color, include color versions in all grant copies.

  Figures should be placed in the text, in an appropriate location; preserve readability and orientation clues

• Orient reviewers
  Outline enough, but not too much. A simple outline provides orienting clues for the reader. Complicated outlines lose the advantage of outlining!

• Show it
  Although materials can be placed in an Appendix, these are sometimes overlooked or lost. If you want the reviewers to see a figure or data, put it in the body of the text.

• No assumptions
  Remember, you are the expert, the reviewer is not. Do not make assumptions. Achieve absolute clarity in your presentation.

• Play to egos
  It does not hurt to be sure to cite study section members’ own work in your references if it is appropriate.
• Sound bites
  Construct the text in digestible bits, ones that preferably refer to each other. Reviewers will not read a grant from start to finish without a break.

• No mistakes
  Must be error free. Spell check. Generally check meticulously for errors.

• Simple style
  Use a writing style that is simple, free from cumbersome syntax or ambiguous meaning.

• Citation accuracy
  Be sure that citations of figures, tables and references in text is accurate.

• Abbreviations.
  Limit them, as the reviewer may have trouble keeping track of them. Be sure to define them, or better yet provide a table that defines all abbreviations used.

• Priorities
  Clarity is of paramount importance.
Parts of an NIH grant - overview

Grant application formats vary somewhat, even within the NIH system. But most funding sources will want you to use a format something like this.

Abstract
brief description of overall rationale, methods, plan; sometimes required to be in layman's language

Budget information
here is where you indicate how much money you want and provide details that justify your proposed budget

Specific Aims
succinct presentation of what you propose to do, preferably phrased in terms of the specific hypotheses to be tested

Background
this is where you explain the rationale for your hypothesis, provide reviewers a background overview of the area, and build your case for why the work you propose is important

Significance
very brief summary of the overall significance of your work

Preliminary Data
presents data accumulated to date and documents feasibility of the proposed work

Experimental Plan
the 'meat' of the proposal, this is where you provide a detailed experimental plan and research methods

Ancillary information
here is where you describe use of human or animal subjects

Consultants
here is where you tell who your consultants and collaborators are, what they will do for you and with you as part of this proposal
Research Plan: Specific Aims

*often a lost opportunity*

**Goal:** Your Specific Aims should provide the reviewer with overall orientation (its official use) and start winning them over (most important). The reviewer's first impression can influence the rest of their review. Use this to your advantage.

On NIH grants, the project's Specific Aims are usually outlined on the very first page of the Research Plan. Obviously, when a reviewer sits down to read a grant, this is where they start reading and, so far, are free of impressions or biases. Therefore........

• start with a brief introductory paragraph

  Orient the reviewer to the topic and its importance. Mention your phenomenally exciting preliminary data. This allows you to establish the link between importance of the problem, your preliminary data, your hypothesis, and your aims.

• follow with a succinct, straightforward statement of specific aims

  State your aims as hypothesis -- the exact same experimental plan can come across like either aimless busy-work or like cutting-edge hypothesis driven research depending upon whether or not it is presented as a hypothesis or not.

  Try to convey not only the hypotheses you will test but also a general impression of how you will approach it

• propose a limited number of aims

  All grants are different, of course, but for most grants you should limit yourself to no more than four aims. Each basic aim, however, can involve several sub-hypotheses and/or multiple experiments.
Research Plan: Background

the most mis-used part of grant applications

Goal: your presentation of Background information should leave the reviewer saying "Wow! This applicant has a great idea regarding a really important problem!"

The Background section should be used for three purposes: to orient the reviewer to your topic area (its official purpose), and to illustrate why your proposal is important (actually its most important role), and to demonstrate the rigor of your analytical abilities (psychological warfare).

• Educate
  Use it to make reviewers knowledgeable enough to review your grant. It should be complete, yet concise. Emphasize the information that is most directly related to your proposal.

• No assumptions!
  Do not make any assumptions about what the reviewer’s baseline fund of knowledge will be. If it is important, spell it out!

• Be to the point
  Don’t use precious space expounding on indirectly related material. Rather, generally cover such material in an introductory paragraph.

• Be honest
  Provide an accurate and unbiased interpretation of the literature and any extant controversies.

• Be rigorous
  Don’t be loose with the truth; eg, don’t say "Smith showed that x causes y" if the fact is really that "Smith made observations that suggest that x causes y".

• Craft it
  Use it to identify knowledge gaps that require study. Do this by specifically pointing out the relationship between Background information and your own Specific Aims. Do not assume that the reviewer will pick up the gaps in current information/understanding (on which your proposal is based) if you don’t pointedly delineate them. Craft your Background section so that the reviewer is ready to embrace your project as being important!

• Self-promotion
  If any Background information is your own work, make sure this is pointed out, either by sentence structure in text or by showing such work in the Preliminary Data section.
Research Plan: Preliminary Data

here is where you show them you can do it

**Goal:** This section serves two purposes. It allows you to document feasibility of a plan (the official purpose) and to bolster the reviewers conviction that this work will go somewhere important (psychological warfare).

- **Doable**
  First and foremost, "feasibility" means it is doable by the applicant. Reviewers will assess this by examining: the applicant's training and track record; available resources; *documented* availability of collaborators or consultants; *documented* availability of scarce/unique reagents; and preliminary data that document technical ability [this is most important, as it shows you can actually perform the necessary techniques].

- **Support hypothesis**
  But "feasibility" also means that the project is likely to succeed in the sense that the hypothesis is correct. Thus, provide intriguing, tantalizing data that provide a compelling *hint* that your hypothesis may actually be true.

- **Remember, it's preliminary**
  Avoid making it look like the work is already close to being done.

- **Anything goes**
  It is ok to use as "preliminary data" something that is even unrelated to your new proposal, if it clearly demonstrates your own relevant technical capabilities.

- **Be convincing**
  Preliminary data need not be extensive; but they must be wholly convincing, to the point, and supportive of your hypothesis.

- **Be explicit**
  Explicitly make the distinction between what has already been done and needs no further work, versus what is just preliminary and requires more study.

- **Show links**
  Extant questions should be identified here and linked to your experimental plan, even if you have already done so in Background section.
Research Plan: Experimental Plan

*without a strong plan, the best idea is worthless*

**Goal:** This is where you convince the Reviewers that your experiments will definitively test the hypotheses. This section is replete with opportunities to make or break the proposal.

- **Persona**
  Most important of all, prepare the application as a reviewer, not as an applicant. That is, rather than getting caught up in the beauty of your idea or the elegance of your experimental approach, try to criticize and find flaws with your proposal. By doing so, you will identify weaknesses that can and should be fixed prior to submission.

- **No assumptions**
  Remember, you are the expert, the reviewer is not. Do not make assumptions about the level of reviewer knowledge. Achieve absolute clarity in your presentation.

- **Clear distinctions**
  Remember that methods, experimental design, and specific experiments are each separate components of a research plan and must be individually clear to the reviewers.

- **Don't confuse**
  Section can be organized in several ways. It may be helpful (to the reviewer) if you separate out methodological details into a separate section (that either precedes or follows the Experimental Plan), because the Reviewer is apt to review your experimental design more critically than the specific methods per se. Thus, details of methods mixed in with design can be distracting and, worse, confusing.

- **Provide orientation**
  Also helpful to the reviewer will be visual clues to orientation, ie an outline or paragraph headings. This will also enable them to read in digestible bits. Be careful, however; too much outline is itself disorienting.

- **Establish linkage**
  Proposed experiments should be presented so it is clear they are tests of specific hypothesis (which ought to be the same as your original specific aims)

- **Be focused**
  Experiments must be focused on discrete hypotheses: the criticism that the plan is "diffuse" is deadly.
• Try to refute
  Keep in mind that it is easy to design experiments that will support your hypothesis. It is a more critical test of your hypothesis to design and include experiments that attempt to refute your hypothesis.

• Stay to the point
  The research plan should convince the reviewer that your approach is focused on the problem at hand; there may be interesting, extra experiments you'd like to do, but don't include them in the plan unless they are truly important to testing your hypothesis.

• Be reasonable
  Propose an appropriate amount of work for the requested funding period. Grants are easily criticized for being "over-ambitious," and they are frequently cut in duration or funding level because not enough work is proposed.

• Escape clause
  An effective way to handle the need to balance these two constraints is to include a section on long term plans at the end of your research plan. This can be identified as describing work that is "beyond the scope of the present proposal" because it is unlikely that you'd get that far in the requested funding period; yet it allows you to indicate the longer-term direction your research would take. Then, if a reviewer thinks you are not proposing enough work for the requested period, he/she may give you a break because they know how you will spend the extra time.

• Anticipate results
  Always briefly describe the anticipated results so reviewers understand how you will translate data into conclusions.

• Anticipate pitfalls
  You must convey to reviewers that you have considered all potential pitfalls and contingency plans. Include a section on "anticipated problems" that demonstrates you have considered these. It also should describe alternative approaches you'll use if necessary. This will help assure reviewers that you have carefully thought through your approach. This item must be taken very seriously and done with careful thought, as it can be deadly if an obvious potential problem has not been identified by the applicant. Your coverage of anticipated problems can either be included along with each aim or be presented in a completely separate section at end of the research plan. Which you chose depends mostly on clarity issues.

• Expect the worst
  A potential flaw in grants is an experimental plan that could inadvertently self-destruct. Don't construct your plan so that a negative result in an early experiment would indicate that the entire remaining proposal does not need to be
done! Reviewers will want to know what is going to happen if your results, especially early ones, clearly show the hypothesis is wrong.

• Consistency
  Plan should be presented keyed to the stated aims/hypotheses, so reviewers understand how your experiments are related to the study's goals.

• Be logical
  Experiments must be proposed in a logical order. If design of one experiment (or whether it is done at all) depends on outcome of a prior experiment, carefully outline your planned decision-making process in this regard. Do not assume the reviewer will do this for you!

• Provide details.
  How many subjects need to be studied, and why? How many mouse experiments do you need to do? How many times will the experiment be done, and why?

• Time line
  Conclude your overall experimental plan with a time-table so reviewers can clearly see what you will do when; this must be realistic, so think about it carefully.

• Describe methods
  Beware of the often-leveled criticism that "methodologic details are missing". Reviewers want to understand what you really will do. But be concise. In a general sense, it is reasonable to aim for a level of detail that would allow a generally knowledgeable scientist to understand what you'll do. On the other hand, details that could vary and make or break an approach need to be spelled out.
Budgets

Overview

• Costs
  total costs = direct costs + indirect costs

  since direct costs comprise the actual cost of doing the work, it is incumbent upon the applicant to be sure these are appropriate

  the applicant has no control over the indirect costs, the institutional overhead charged by the University

• Scope
  In general it is wise to construct the budget after the specific aims and research plan are developed, so the full scope of the project is identifiable. On the other hand, for grants with very limited budgets (generally, the 'starter' grants) the amount of work proposed will be dependent upon available funds.

Essential rules

• Less is more
  A good rule of thumb is that a lower budget is better; the higher the budget, the more likely that reviewers or NIH program staff will get picky about it.

• Be accurate
  Yet, amounts requested should be carefully considered; an underestimate of research cost can be a deadly flaw in an otherwise terrific grant.

• Match it
  The proposed budget must match the proposed work; i.e., only truly appropriate expenditures are included supplies, personnel, or equipment.

• Watch the time frame
  Your proposed budget must match the proposed time-frame; e.g., don't request funds in year 1 for parts of the work that won't be started until year 2

• Justify it
  Everything must be justified. A budget is less likely to be adversely modified if it is clearly evident that all components are truly needed and costs are correct.
Personnel budgets

• the actual role of all participants should be specifically defined

• indicated efforts should correspond appropriately to these stated tasks; ie, state what each will contribute to the grant that justifies the requested % effort

• % effort must correspond to projected time table; e.g., an employee with a certain skill will appear unneeded in year 1 if experiments requiring that skill are not to be done until year 2

• very low % effort for a PI (< 10%) is a warning sign that he/she may not be able to contribute sufficient attention to the project

• personnel should have appropriate experience/training for proposed role; this should be described

• the more FTE you request, the more reticent the reviewers will get; this does not mean you should request less staff than you need; but it again argues for precisely crafted justification

• if your department requires salary on a grant to match % effort, say so

• reviewers will not know what a "junior scientist' at the University of Minnesota is qualified to do vis-à-vis such descriptors elsewhere. You should explain why requested personnel have the requested skill level

• listing names of real people is better than 'to be named'

Supply budgets

• list requests by categories that make sense for the proposed work (e.g., disposable supplies, biochemicals & reagents, antibodies, isotopes, etc.)

• requests for funds must be appropriate for the kind/amount of work proposed; e.g., molecular biology costs much more than physiology

• justify general category amounts requested based on real calculations; e.g., based on 'our prior experience with these types of experiments', or on 'known rate of expenditures in this lab per FTE' etc.

• justify specific categorical purchases (e.g., isotopes or antibodies) based on actual commercial purchase prices and expected use
• if rare/unique reagents will be used (e.g., probes or antibodies that are not commercially available) provide a letter from the source documenting their availability to you

**Travel budgets**

• generally, travel to one appropriate meeting (define in budget justification) is readily justifiable for the PI of a grant. The travel should for something important to your project: be to present your data, interact with other scientists in the area, keep up to date with latest developments, etc.

• more than one trip gets problematic, but it is possible with sufficient justification

• foreign travel usually in not allowed, although Canada can be an exception for collaborative research

**Equipment budgets**

• justify every requested item, indicating relationship to existing resources

• be specific in requests, listing model numbers, total purchase price, source of item

• note that equipment purchase price often can be increased by 5-10%, justified by an "anticipated price increase"

• don’t ask for an equipment item that is already listed as available in the Resources and Environment summary (unless you can justify the reason)

• indicate the % use on this project a requested equipment item will be used; expect the NIH to provide only for that % of the total cost corresponding to use on this project; i.e., it requires serious justification and persuasion to secure 100% of the purchase price for something that will only be used 50%. Plan on obtaining 'matching funds'.

**'Other' Expenses**

• this is the place to list anticipated expenses not covered by the other, specific categories

• note that many legitimate costs of doing research (e.g., office supplies, secretarial support, monthly phone access costs) are not allowable as expenses under NIH rules

• it therefore is essential to thoroughly request coverage for expenses that are allowable such as anticipated project-specific long distance phone costs, shipping expenses, animal housing expenses, computer paper, Xeroxing or library fees, manuscript submission fees or page charges, equipment service costs, and so on; as usual, each must be specifically justified
• animal costs should be explained (i.e., cost per day per animal x number of animals needed x length of housing required)