Writing Successful Research Grant Proposals

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Handouts

1. Slide copies
2. Review Criteria Table
3. Guidelines for Writing and Reviewing a Research Grant Proposal (R01 and K grants)
4. Make Every Word Count Twice
5. K-award Examples
6. Online Grant Funding Information
1. Glossary of Confusing NIH Terms
   http://grants.nih.gov/grants/glossary.htm

2. NIAID Funding Center
   – Excellent tutorials at:

3. Look for new tools at:
   http://grants.nih.gov/grants/grant_tips.htm
Learning Objectives

1. Discuss extended benefits of writing a proposal
2. Plan in advance
3. List three strategic goals of grant proposal
4. Explain how Specific Aims can sell proposal
5. Describe strategies and content for each section of Research Plan
6. Address NIH review criteria throughout a proposal
Why Write a Research Grant Proposal?

1. Establish your commitment to this project (rather than 10 others)
2. Clarify and focus research question, strategy, design, and methods
3. Identify needs
4. Develop team
5. Communicate plans with colleagues
6. Negotiate over resources, using grant for leverage
7. Obtain money, promotions, prestige
Planning the Proposal
Think Before You Begin to Write
Conceptual Planning: What is the science behind the project?

• What is the main question to address? The objective? Public health significance?
  How does the project fit into your field?
• What specific hypotheses will you test?
  What experiments will give you answers most productively?
• Do you have enough preliminary data to show feasibility and experience?
Strategic Planning: Who will fund the project?

- Who has funded projects on your topic?
- What does your targeted funding agency invest in?
- Who should you contact?
- Do the agency’s goals overlap with yours? Can you recast your project to match their interests?
- What kind of reviewer will read your proposal?

Tailor proposal to audience’s interests and level of expertise
Logistical Planning: How will you carry out the project?

1. What essential resources are needed?
   - Time, staff, equipment, space
   - Research materials (patients, samples, cell lines, reagents)
   - Required approvals (IRB, animal care)
   - Collaborators and consultants

2. What resources must grant provide?
   What already exists?

3. How will you coordinate your aims, timeline and budget?
**Sample of Project Timeline***

<table>
<thead>
<tr>
<th>Specific Aims</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
</tr>
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<tbody>
<tr>
<td>Aim 1a: Identify subjects</td>
<td>xx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aim 1b: Chart review</td>
<td>xxxx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aim 1c: Data analysis, ms prep</td>
<td></td>
<td></td>
<td>xxxxx</td>
</tr>
<tr>
<td>Aim 2a: Recruit subjects</td>
<td></td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>Aim 2b: Conduct intervention</td>
<td>xx</td>
<td>xxxx</td>
<td></td>
</tr>
<tr>
<td>Aim 2c: Follow-up and assess outcomes</td>
<td></td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>Aim 2d: Data analysis</td>
<td></td>
<td>xx</td>
<td>xxxx</td>
</tr>
<tr>
<td>Aim 2e: Interpretation, ms preparation</td>
<td></td>
<td></td>
<td>xxxxxx</td>
</tr>
<tr>
<td>X = 2 months</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* See Models for detailed timeline examples
Grant planning timeline

6 mo  Read literature & craft good question
      Write specific aims & get input from others
      Plan & negotiate, organize & assign tasks

3 mo  Draft Significance, Innovation
      Draft Approach (initiate subcontracts)

6 wk  Get critical reviews from others

3 wk  Edit & perfect (receive subcontracts)

2 wk  Send to Grants Office

0 wk  Submit
The more you plan in advance of writing:

- the less time you will waste on crafting language for the wastebasket
- the more clear and focused final proposal will be
Writing an NIH Grant Proposal
Primary Goals of a Grant Proposal

1. Persuade reviewer of importance of work
2. Persuade reviewer of your ability to do the work
3. Describe study clearly and completely
Most Common Reasons for NIH Grant Disapproval

1. Lack of new or original ideas (1,2)
2. Absence of acceptable scientific rationale (1,2)
3. Unfocused, superficial or overly ambitious research plan (2,3)
4. Uncritical approach (2)
5. Lack of knowledge of published, relevant work (2)
6. Lack of preliminary data or experience in essential methodology (2,3)
7. Uncertainty concerning future directions (2,3)
8. Lack of sufficient experimental detail (2,3)

Goals: 1. Importance  2. Ability to do it  3. Clear description
NIH Grant Types

- **R Grants:** Investigator-initiated R01, R21, R03
- **K Grants:** Career Development Awards
- **F Grants:** Training grants for pre- and post-doctoral students

Common element: the Research Plan
NIH Review Criteria

1. **Significance**: importance of problem, new knowledge to be gained, impact on scientific field or clinical care and prevention

2. **Investigators**: investigator or team training, experience, past productivity

3. **Innovation**: novel concepts, approaches, methods, technologies, or interventions

4. **Approach**: conceptual/clinical framework, design, feasibility/risk management, methods, analytic plan, alternatives, human subjects protection and inclusion

5. **Environment**: supportive scientific environment, unique subject populations, collaborative arrangements, institutional support

Summative score = **IMPACT**

“assessment of the likelihood for the project to exert a sustained, powerful influence on the research field(s) involved”
Impact is “...likelihood for the project to exert a sustained, powerful influence on the research field(s) involved...”

- **Likelihood** (i.e., probability) is primarily derived from the investigator(s), approach and environment criteria.

- **Sustained powerful influence** is primarily derived from the significance and innovation criteria.

- **Research field(s)** may vary widely, so it would be helpful if reviewers identify in their reviews the research field(s) they believe will be influenced by each project.
Outline of an NIH Grant Proposal

Title
Abstract and Key Personnel
Table of Contents
Budget and Budget Justification
Biographical Sketches/Other Support
Resources

GRANT NARRATIVE (13 pages)

Literature Cited
Letters of Support
Appendix
# Outline of R01 Narrative

<table>
<thead>
<tr>
<th>FORMAT</th>
<th>PAGES</th>
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<tr>
<td>SPECIFIC AIMS</td>
<td>1</td>
</tr>
<tr>
<td>RESEARCH STRATEGY *</td>
<td>12</td>
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<tr>
<td>Significance</td>
<td>~2</td>
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<tr>
<td>Innovation</td>
<td></td>
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<tr>
<td>Approach</td>
<td>~10</td>
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<tr>
<td>• Study Design</td>
<td></td>
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<tr>
<td>• Preliminary Studies</td>
<td></td>
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<tr>
<td>• Methods</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
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</tbody>
</table>

* K-award, R03, R21: 1 + 6 pages
Specific Aims: Strategies

- Be brief (now 1 page maximum)
- Introduce essential elements of proposal
- Outline proposed work
- Discuss impact of study
Specific Aims: Content

1. State purpose of proposed work
2. State general question or hypothesis
3. Explain context from which study emerged:
   - previous work or pilot data
   - special clinical interests
   - problem in field
4. Identify model, system or sample
5. List proposed experiments and hypotheses
6. Describe long term impact of your research program
Strategy:

- Review literature selectively and critically
- Show how proposed work will fill gaps in knowledge in your field
- Emphasize impact
Significance:

Content

- Identify critical problem or barrier to progress in field
- Show its importance
- How will project will address this problem?
- How will the field be changed by this project?
Significance: Organization

1. Broad view: State why work is important in broad context of public health or science
2. Optional: Outline conceptual model for work (e.g., diagram of hypothetical causes and effects)
3. Review status of knowledge in field to justify your Specific Aims*
4. Restate importance of work: how will the field change if aims are achieved?

* Spotlight opportunity
Proposed Metabolic Syndrome Factors in the Life Course from Obesity to Cardiovascular Disease

Potential Precursors:
- Adiponectin
- Other inflammatory cytokines

Abdominal Obesity
- Dyslipidemia
- Elevated BP
- Abnormal glucose-insulin metabolism
- Pro-inflammatory factors
- Pro-thrombotic factors

Tobacco use/exposure

Genetics, Perinatal, Puberty, Diet, Physical Activity

Childhood                         Adolescence                      Adulthood

Bold = factors included in this study
Research Strategy: Innovation

• How will project challenge or shift current research or clinical practice?
• Does the study use new concepts, approaches, or methods?
• How will it improve on current methods or theoretical concepts or apply them in a new way?

This section is closely related to Significance—may be a bulleted summary
Research Strategy: Approach

- Describe overall strategy, methodology, and analyses (a.k.a. Research Design)
- Discuss potential problems and alternative approaches
- Address feasibility
- Downplay experimental details
Approach: My Suggested Sequence

- Research Design
- Preliminary Studies
- Methods*
- Analysis of Results

* Methods will be much briefer than in previous proposals
Approach: Potential Formats

- Wholly integrated
- Divided by aim
- Combined approach
  - Research Design
  - Preliminary Studies/Progress Report
  - Methods for Aim 1, Aim 2, Aim 3
  - List of methods shared across Aims
  - Analysis of Results
Approach: Strategies for Research Design

- Outline study design
- Explain rationale for selecting this design, including compromises
- Clarify how design addresses your primary questions/hypotheses
- Discuss implications of limitations; offer alternative approaches
Approach: Content of Research Design

- **Summary of research design**
  - Design graphic
  - List of key measures (usually outcomes)
  - Timeline of experiments

- **Rationale for design**
  - Stick to pragmatic issues (*not* significance)
  - Defend all critical choices in designing the study; explain compromises
  - Explain any contingencies in aims and design limitations
Approach: Strategies for Preliminary Studies

- Provide provocative data to support your choice of specific aims
- Demonstrate ability to do the proposed work:
  - critical thinking skills
  - technical expertise
- Demonstrate feasibility of study
Preliminary Studies: Content

1. Summarize and critically interpret preliminary studies, showing how they support proposed work*

2. Document availability of and experience with required population, models or reagents

3. Document experience with proposed methods, or availability of experts

* Spotlight opportunity
Approach: Strategies for Methods

- Document previously published methods with citations only (consider a table)
- Devote space only to methods that are crucial to the study and unpublished
- Offer alternative approaches to challenging experiments
Methods: Content

- Format for quick reference; organize around Aims
- Use table to cite previously published methods
- Emphasize strategy > details, eg, expected outcomes, data interpretation, pitfalls and contingencies*
- Describe alternative approaches*
- Refer to letters of support for more details

* Spotlight opportunity
Use of an Aims + Methods Diagram

Aim 1
non-activated eosinophil
primed (pre-activated) eosinophil

GM-CSF → Asthma

Increased response to chemotactic and degranulating stimuli
protein (L-plastin) phosphorylation & expression

Aim 2

GMR
PKC
L-plastin
GM-CSF
PKC inhibitor
pPKC
p-L-plastin

Formation of GMR-PKC-L-plastin signaling complexes

Aim 3

αMβ2
actin
L-plastin
p-2-19 peptide

Signaling downstream of L-plastin
Leading to integrin upregulation and eosinophil priming
protein phosphorylation

Aim 1
non-activated

Aim 2
primed (pre-activated)

Aim 3

Used with permission of Konrad Padzrak, MD, PhD, Assistant Professor of Biochemistry & Molecular Biology, NHLBI Proteomics Center, UTMB
Approach: Analysis of Results

- Describe statistical approach and methods (in English)
- Discuss predicted outcomes and their relationship to hypotheses
- Provide alternative approaches to analysis and interpretation*

* Spotlight opportunity
A BRIEF Finale: 3-4 sentences

- Summarize project limitations
- Remind about project importance and strengths
- End with strong statement about project impact
Make Every Word Count Twice:

How to squeeze your NIH proposal into half the space
Make every word count twice: Fly high

- Work to achieve the 30,000 ft perspective
  - Practice your “Big Picture” skills
  - Develop your elevator speech
  - Tell it to your Mom

- Craft a 30,000 ft and a 5,000 ft summary statement and refer to these as you write

- Practice focus on design > methods, approach > techniques

- Create the context (big picture) carefully, then add details only as needed (e.g. use examples to clarify and energize)
Make every word count twice: Fight for brevity

• Practice the rules of brevity:
  – Build sentences around the best subject
  – Choose strong verbs for compact power of expression
  – Use active voice to simplify sentences
  – Avoid abstractions and long-winded, abstract sentences
  – Avoid empty phrases ("due to the fact that...")
  – Use controlled parallel constructions to build embedded lists

GO TO: http://www.academicpeds.org/espauthoring/page_01.htm

• Make your pictures worth 1000 words: use figures and tables to reduce need for narrative

• Use smart formatting simplify navigation and emphasize critical phrases

• When you repeat for emphasis, use new words to give a new spin or added meaning
Exploit sections outside the page limits

- Use **Bio Sketches** (all of them!) to highlight your skills, and clarify roles of your collaborators.
- Use **Resources** to build your image while reinforcing institutional commitment; describe core facilities, patient resources, IT, shared equipment/laboratories.
- Use **Human Subjects** to discuss many subject issues (recruitment, inclusions, sampling).
- Use **Letters of Support** to amplify on institutional support, co-investigator/consultant roles, methods.
PI biographical sketch

Consider including:

- Personal statement about why you are the one to do this study (required)
  - Experience and productivity
  - Past contributions
  - Important institutional roles
- Access to patients, materials and resources
- Relevant publications that might otherwise be put in Preliminary Studies
Co-investigator bio sketches (personal statements)

Consider including:

- Special role(s) in project
- Unique expertise (training and experience)
- Unique resources available
- Leadership positions
- Specific activities that contribute to the project
Resources

Consider including:

- Relevant facilities, including equipment
- Details of methods performed in core facilities
- Special patient populations
- Unique features of scientific environment that increase likelihood of success
- Institutional investment in PI: faculty development and research training opportunities, administrative and financial support
Human Subjects

Consider including details on:

- Subject recruitment and sampling
- Inclusion/exclusion criteria
- Sample size and power
- Specimens to be collected
- Data management and security
Letters of Support

- Offer to draft for the author and make them all different!
- Include author’s:
  - Familiarity with PI
  - Interest in the project
  - Relevant credentials, standing in the field
  - Anticipated level of participation
  - Specific contributions to the project
Reprise of NIH Review Criteria

1. **Significance**: importance of problem, new knowledge to be gained, impact on scientific field or clinical care and prevention

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NIH K-Awards
NIH Grant Types

- **R Grants**: Investigator-initiated R01, R21, R03
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**Common element: the Research Plan**
Components of a K-Award

Candidate’s Statement

- Candidate’s Background*
- Career Goals and Objectives*
- Career Development/Training Activities*

Sponsors, Consultants, and Collaborators

Environment and Institutional Commitment to Candidate

Specific Aims + Research Strategy*
Relationships Among Key Parts

Candidate’s Background (~1 pp)
Career Goals and Development Plan (~3 pp)
Specific Aims (1 p)
Research Strategy (~8 pp)

- These sections need to complement and reinforce each other
- For reviewers, Research Strategy is the main act, but Candidate statement sets the stage
Strategic Alignment

Candidate’s Background
- Articulated series of “growth steps”
- What these steps taught you
- Pathway to discovery of research career focus

Career Goals and Development Plan
- Identification of new knowledge and skills required to achieve career goals
- Specific plans to achieve them
- Dovetailing of career develop plan & res strategy

Research Strategy
Candidate’s Background

• Create a carefully tailored biography:
  – Where have you been? What have you accomplished? (Use first person--sparingly)
  – What have you learned? How did you discover your passion?
  – Culminate with: **YOUR CURRENT CAREER GOAL**

• How does this experience prepare you for the proposed research?

• Establish a theme that will carry through the whole proposal
Career Development Plan

- Show that CD plan aims at specific research targets
- Combine timelines for career dev and research project
- CD objectives should be linked explicitly to diversified CD plan (see K-handout, p.1-2)
- Mentoring: Who, what and when

Coordinate carefully with research plan!
Distinguish CD objectives from research aims.
Career Development and Research Timeline

- Plot all activities against all years
- Be specific (e.g., course names) to save room in narrative
- Show how coursework will prepare for independent study/mentored learning
- Show how all CD activities will precede and prepare for research project
# Outline of K-proposal

<table>
<thead>
<tr>
<th>SECTIONS</th>
<th>PAGES</th>
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<tbody>
<tr>
<td>CANDIDATE STATEMENT</td>
<td>3-4</td>
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<tr>
<td>SPECIFIC AIMS</td>
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<tr>
<td>RESEARCH STRATEGY *</td>
<td>8-9</td>
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<td>o Approach (Study Design, Preliminary Studies, Methods)</td>
<td>~6-7</td>
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