

Writing Specific Aims

Thursday November 7, 2019

Daichi Shimbo, MD

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Outline

- Presentation (40 minutes)
- Working in pairs to review aims (30 minutes)
- Q&A period (20 minutes)

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Writing Specific Aims

How do I structure a compelling research question?

How do I structure a specific aims page?

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Compelling research question

- The research question is the objective of the study, the knowledge gap that the investigator wants to solve.
 - General question
 - Should people exercise?
 - Focused question (preferred)
 - Does isometric exercise lower blood pressure for individuals who have hypertension?

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Compelling research question

- Research question
 - General question
 - Does systematic changes in the electronic health record (EHR) improve cardiovascular risk?
 - Focused question
 - Does EHR alerts based on underlying baseline cardiovascular risk improve the rate of appropriate statin administration for individuals without cardiovascular disease?
- Quality assurance versus scientific research question

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Compelling research question

- FINER
 - **F** = Feasible
 - **I** = Interesting
 - **N** = Novel
 - **E** = Ethical
 - **R** = Relevant (timely)

Source: *Designing Clinical Research*, 4th ed. Hulley, Cummings, Browner, Grady, Newman, 2013.

Identifying a compelling research question

- What is known? ("Why should I care?")
 - Talk to mentors
 - Conduct an extensive literature search
 - Focus on systematic reviews, narrative reviews, and editorials
 - Use relevant search terms
 - Related article search
 - Web of science
- This takes the longest time and is difficult for most early stage investigators (in my opinion).

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Identifying a compelling research question

- Web of science (demonstration)
 - http://apps.webofknowledge.com/WOS_GeneralSearch_input.do?product=WOS&search_mode=GeneralSearch&SID=4DOrDx4mc31xJDz6TgZ&preferencesSaved=
 - Example:
 - *Prognostic accuracy of day versus night ambulatory blood pressure: a cohort study*

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Identifying a compelling research question

- What is not known?
 - What are the knowledge gaps?
 - What are the limitations (internal and external validity) of the prior studies?

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Identifying a compelling research question

- What is the research question(s)?
 - Should address important knowledge gaps
 - Answering this question will lead to new/novel scientific knowledge
 - Will influence the field, and may change current paradigms
 - May lead to changes in scientific statement/guideline recommendations/conceptual models
 - Avoid “me also” research questions

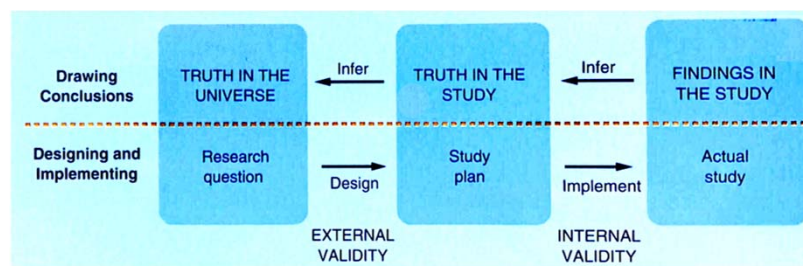
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From research question to aims and hypotheses

- Research question
- How do we go from research question to aims / hypotheses?

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Overview



Research question

Aims / hypotheses

Hulley et al. Chapter 1.

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Overview

- **Truth in the universe**
 - **Target population:** people with coronary heart disease (CHD)
 - **Phenomena of interest:** % who take fish oil supplements?
- **Truth in the study**
 - **Intended sample:** all patients with history of CHD seen in cardiology clinic at CUMC for the last year
 - **Intended variables:** self-reported use of fish oil supplements
- **Actual study**
 - **Actual subjects:** smaller group of patients with a CHD diagnosis in the EHR in the prior year who filled out a questionnaire about supplements
 - **Actual measurements:** response to questionnaire about fish oil supplements

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Specific Aim

- **Specific Aim**
 - What are you specifically proposing to study?
 - Primary Aims
 - Secondary Aims
 - Exploratory Aims
- **Aims should be independent of one another**
 - Does the failure of one aim invalidate another aim?
- **There should be a logical flow of the aims**

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Research Question vs. Aim

■ Example 1

- **Research Question:** Does lowering dietary salt intake affect blood pressure among those at risk?
- **Primary Aim:** To determine whether a reduction of dietary sodium intake leads to a reduction in blood pressure among middle-aged individuals with a history of heart disease.

■ Example 2

- **Research Question:** Do multi-vitamins impact cancer risk?
- **Primary Aim:** To determine whether long-term multi-vitamin supplementation decreases the risk of total and site-specific cancer events among men.

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Hypothesis

■ Hypothesis

- What is your expected finding?
- A statement derived from a theory that predicts the relationship among variables representing concepts, constructs, or events (Mosby's 5th ed.)
- A research hypothesis is a **specific, testable prediction** about what will happen under a given set of circumstances or conditions

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Hypothesis

- **Hypothesis**

- Primary Aim
 - One hypothesis or multiple hypotheses per Primary Aim
- Secondary Aim?

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Aim and Hypothesis

- **Example**

- **Primary Aim 1:** To compare the difference between clinic blood pressure and daytime blood pressure on ambulatory blood pressure monitoring when clinic blood pressure is assessed using the unattended versus attended automated oscillometric method.
- **Hypothesis 1:** The difference between clinic blood pressure and daytime blood pressure on ambulatory blood pressure monitoring will be smaller when clinic blood pressure is assessed using the unattended versus attended automated oscillometric method.

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Specific Aims Page

- What is the health care/biomedical research problem (topic) and how important is it. What is the unmet need.
- What is already known and accepted in this area
- What is the problem, roadblock, the unknown (i.e. the “research question”)?
 - Limitations of prior studies
 - Unaddressed questions
- Long-term goal = What final “big result” will the research help achieve down the road ?
- What is the specific narrow goal of this research?
 - Statement of the research question of your study
- How will your study address:
 - Limitations of prior studies and what is not known
 - The research question

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Specific Aims Page

- How your study is innovative
- Statement of specific aims and hypotheses
 - If the aims/hypotheses are met, what are the implications for the unmet need?
 - If the aims/hypotheses are not met, what the implications?
- Study design
 - Alternatively, this can go above aims/hypotheses.
- Health implications (summary)

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Career Development Awards

- **Mentor and mentorship plan**
- **Candidate description** (who are you? what are your career goals? why do you need training? Not a personal statement per se)
- **Career development and career goals**
 - Long-term career goals
 - Short-term career goals (**training aims**)
 - Addressed by training modules (approach)

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Career Development Awards

- **My long-term goals are to:**
 - Build a high productive, independent laboratory to continue my scientific investigations into preventive cardiology.
 - Train and mentor future clinical researchers as they develop into independent scientists.
 - Develop a strong network of collaborators within the research community.
- **My short-term goals (i.e. aims) are to:**
 - Have formal training in the design, conduct, and evaluation of clinical trials including randomized controlled trials.
 - Acquire statistical expertise in the analysis of longitudinal data.
 - Have further training in relevant laboratory techniques applicable to conducting patient-oriented laboratory-based research.
 - Have further training in preventive cardiology.
 - Refine my ability to articulate research ideas and findings.

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Career Development Awards

Training Module	Mentors	Mode of Learning
1. Clinical Trials Design	Pickering & Davidson	Graduate coursework Weekly research meetings Applied training
2. Statistics	Chaplin	Graduate coursework 1-on-1 meetings every other week
3. Basic Science Methodology	Badimon	Graduate coursework Weekly research meetings Applied laboratory training
4. Preventive Cardiology	Pickering	Weekly research meetings Clinical experience Guided reading
5. Medical Research Dissemination	Pickering & Davidson	Collaboration on submitted manuscripts and R01 applications

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Specific Aims Page

- Typically one page in length (no greater)
- Minimum and essential for a proposal in development
 - Deciding if good science
 - Deciding if feasible (i.e. is science overambitious)
 - Deciding who is on the investigative team
 - Deciding initial statistical plan and power analyses
 - Determining if study is overbudget
- Show it people outside your area and get feedback
- When finalized, rest of the application will come easily

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Typical reviewer



MENTALLY
EXHAUSTED

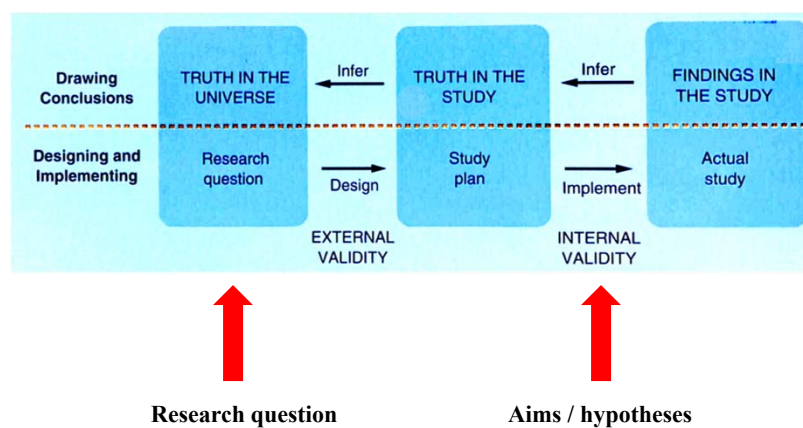
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Scientific Writing – Advice

- Be concise and crystal clear
- Be somewhat redundant throughout the writing
- Speak to a more general research audience
- Highlight gaps and innovation; and state what happens when your study is done successfully

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Overview



Hulley et al. Chapter 1.

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Handouts

- Six handouts

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Specific Aims Page (maximum 1 page)

Your specific aims page should be structured as follows:

- What is the health care/biomedical research problem (topic) and how important is it?
What is the unmet need (ie. Gaps in knowledge, ways this will bring the field forward)?
- What is already known and accepted in this area?
- What is the problem, roadblock, the unknown?
 - Limitations of prior studies
 - Unaddressed questions
- Long-term goal: What final "big result" will the research help achieve down the road?
- What is the specific narrow goal of this research?
- Statement of the research question of your study
- How will your study address:
 - Limitations of prior studies and what is not known
 - The research question
- How is your study innovative?
- Statement of specific aims and hypotheses
 - If the aims/hypotheses are met, what are the implications for the unmet need?
 - If the aims/hypotheses are not met, what the implications?
- Study design (for clinical/population-based research: population to be studied, sample size, source of subjects, measures etc.; for basic science: animal model, cells, protein, experimental procedure etc.)
 - Alternatively, this can go above aims/hypotheses.
- Public health implications (summary)

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Research Strategy (i.e. Significance, Innovation, Approach sections) (the page limit is dictated by the type of application you are submitting – please review NIH application instructions carefully to find out what the page limit is).

Significance: Does the project address an important problem or a critical barrier to progress in the field? Is there a strong scientific premise for the project? If the aims are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved?

- Suggest format: Provide background of scientific area. What is already known. What is not known (i.e. scientific gaps in knowledge). Why do these gaps matter for human health. Describe overall research question. How will your study address these gaps.


Innovation: Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions? Are the concepts, approaches or methodologies, instrumentation, or interventions novel?

Approach:

- Overview of study design and methods to be used, and how they are appropriate for assessing your hypotheses.
- Study design: Include strengths and advantages of your chosen design, discussion of possible alternatives and the reasons for not choosing them. Tie your choice of design to your specific aims, and why it works.
- Subjects
 - Population being targeted
 - Entry criteria & recruitment information
 - Any issues related to eligibility/attrition
 - Randomization procedures (if applicable)
- Variables
 - Exposure(s)
 - Outcome(s)
 - Adjustment variables (covariates)
- Statistical plan
 - For each aim, describe the statistical procedures and techniques you will apply to address your main hypotheses; tie explicitly to your specific aims.
 - Plans for data management (where/how will data be collected and stored)
 - Sample size justification: Give a justification (power or precision) for the sample size you will employ.
- Potential problems, pitfalls, and alternative strategies
 - Describe problems that you foresee and strategies for overcoming them.
- Timeline and benchmarks
 - Give a timeline and possible benchmarks that you can use to monitor your progress.

References (no limit)

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CLIMB

Collaborative Learning and Integrated Mentoring in the Biosciences

<https://www.northwestern.edu/climb/resources/written-communication/index.html>

[Current Students](#) | [Prospective Students](#)

[PROGRAM DESIGN](#)
[MENTORING](#)
[RESOURCES](#)
[ABOUT CLIMB](#)
[CONTACT US](#)

WRITTEN COMMUNICATION

Being a scientist means more than just doing exceptional research. A good scientist is also a good writer. In fact, you won't truly be successful as a scientist until you learn to write well. You have to publish papers and apply for grants to fund your work. In fact, your career depends on the ability to write well.

The resources below are designed to help you improve your writing skills. The advice provided here is not only actionable and practical, it's science-based. The advice is designed to "de-mystify" the writing process. These resources focus on skills you can quickly master, no matter how you view yourself as a writer, and no matter how complex and subtle the science is.

The links below lead to PowerPoint or video files used for our workshops for second year CLIMB students when we focus on written communication skills.

View a PowerPoint or video file:

- Key Science Writing Skills
 - 5 Principles for Writing Readable Sentences
 - Creating Coherent Paragraphs: Topic Sentences, Echo Words, Transitions
- NIH Grant and Dissertation Proposals
 - Aims Pages, Part 1: Rhetorical Patterns
 - Aims Pages, Part 2: Specific Aims
 - Understanding NIH Review Criteria
 - NIH Grants: Analyzing the "Big Structure" of a Funded Proposal
 - NIH Grants: Exploring the "Significance" and "Innovation" Sections
 - NIH Grants: Analyzing the "Approach" Section
- NSF Grant Proposals
 - Meeting Abstracts-Best Practices in Writing
 - Tables-Best Practices in Designing
- Graph
- Books on Scientific Writing
- Research Proposal Outlines
- Keys to Writing Successful NIH Research and Career Development Grant Applications

QUICK LINKS

- [Contact Us](#)

NORTHWESTERN BIOSCIENCE PROGRAMS

- [Biomedical Engineering \(BME\)](#)
- [Chemical and Biological Engineering \(ChBE\)](#)
- [Driskill Graduate Program in the Life Sciences \(DGP\)](#)
- [Interdepartmental Biological Sciences \(IBIS\)](#)
- [Northwestern University Interdepartmental Neuroscience \(NIUN\)](#)

AIMS PAGES, PART 1: THE RHETORICAL PATTERN OF INTRODUCTIONS IN AIMS PAGES

Below is the first of two videos on writing successful aims pages in dissertation proposals and in grant applications. In this video, we "deconstruct" the introductory material of two examples from grants that received NIH funding, analyzing the rhetorical patterns that make these aims pages successful. (In the second video, which you can find [here](#) we look at the specific text of the aims themselves.)

Make sure you select 720p HD on the video (bottom right corner) for best resolution and so scientific illustrations and figures are clear.

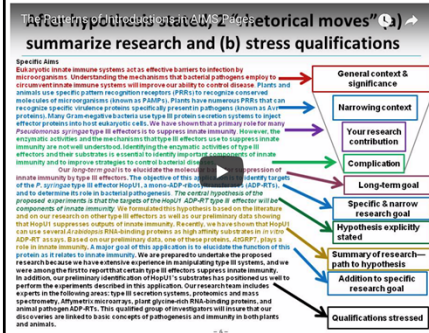
You can download the aims page examples at the links below:

[Aims Page Example 1](#)

[Aims Page Example 2](#)

You can also find this video, and others related to scientific communication, at the CLIMB youtube channel:

<http://www.youtube.com/climbprogram>



AIMS PAGES, PART 2: PATTERNS AND CONTENT IN THE SPECIFIC AIMS AND CONCLUSIONS IN AIMS PAGES

Below is the second of two videos on writing successful aims pages in dissertation proposals and in grant applications. In this video, we "deconstruct" the specific aims and concluding material of an aims page in a grant application that received NIH funding. (You can find the first video in the sequence [here](#).)

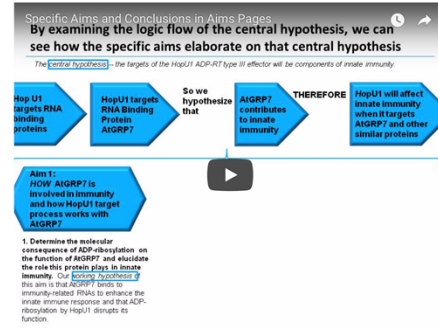
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[Aims Page Example 1](#)

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<http://www.youtube.com/climbprogram>



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Suggested worksheet and outline for aims and research strategy.

Aims and Proposal Outline – R01 or Other Independent Grant Application

Your Name: Your Academic Title: Your Email Address: Project Title: Mentors with Academic Titles, and Email Address:
Overall Research Question (or Goal) What is the overall research question you are trying to answer?
Specific Aims with Corresponding Hypotheses* Specific Aim – what are you proposing to study? Hypothesis – what is your expected finding?
Aim 1. Hypothesis 1. Aim 2. Hypothesis 2. Aim 3. Hypothesis 3. Etc.
Significance Does the project address an important problem or a critical barrier to progress in the field? Is there a strong scientific premise for the project? If the aims are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved? State in outline form.
1. 2. 3. Etc.
Innovation Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions? Are the concepts, approaches or methodologies, instrumentation, or interventions novel? State in outline form.
1. 2. 3.

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Suggested worksheet and outline for aims and research strategy.

Aims and Proposal Outline – K Application

Your Name: Your Academic Title: Your Email Address: Project Title: Mentors with Academic Titles, and Email Address:
Career Development What are your long-term career goals? 1. 2. 3. Etc.
Training What kind of training do you envision needing to attain your long-term career goals? 1. 2. 3. Etc.
Overall Research Question (or Goal) What is the overall research question you are trying to answer?
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Significance

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Why Academics Have a Hard Time Writing Good Grant Proposals

Robert Porter
Journal of Research Administration; Fall 2007; 38, 2; ABI/INFORM Global
pg. 37

**Why Academics Have a Hard Time
Writing Good Grant Proposals**

Robert Porter, Ph. D.
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Virginia Tech
340 Burruss Hall, MC0244
Blacksburg, VA 24060
(540) 231-6747
reporter@vt.edu

Author's Note

This paper was presented as part of the 2006 Symposium at the annual October meeting of the Society of Research Administrators International in Quebec City, where it was awarded Best Paper of the Year.

Abstract

This paper discusses the contrasting perspectives of academic prose versus grant writing, and lists strategies grant specialists can use to help researchers break old habits and replace them with techniques better suited to the world of competitive grant proposals.

Introduction

When they are new to the grant game, even scholars with fine publishing records can struggle with proposal writing. Many are surprised to find that the writing style that made them successful as academics is not well suited to crafting a winning proposal. To succeed at grant writing, most researchers need to learn a new set of

the relationship between workplace experiences and supervisor-targeted aggression. Indeed, despite the differential effects of situational and individual difference factors on aggression, it is notable that the individual difference factors exerted a consistent but relatively low-level effect on aggression across contexts,

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Examples of Specific Aims Page

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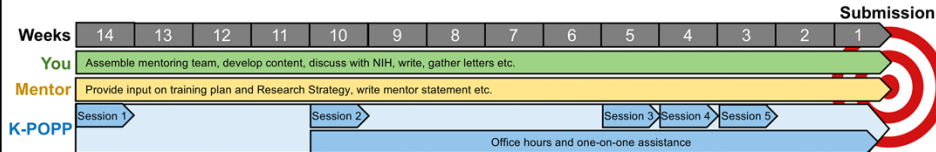
Additional Resources

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Submitting a K Award for the February 12th deadline?

Sign-up for K-POPP

(K Award Program for On-time Proposal Preparation)

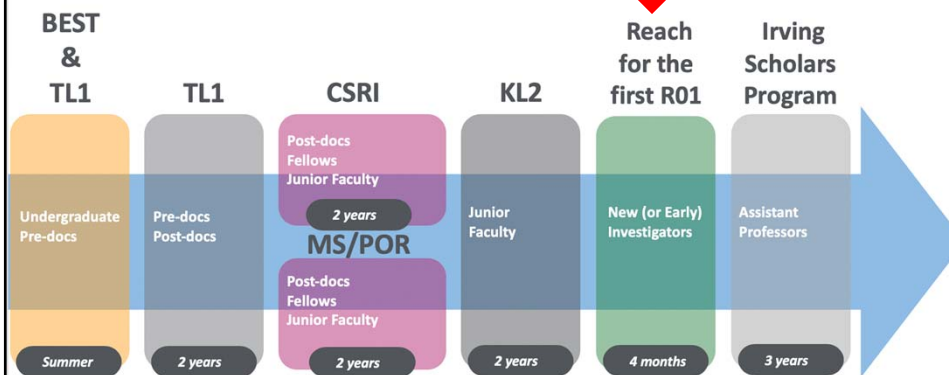


To sign-up, visit www.ps.columbia.edu/k-popp

Questions? Email Danielle Matsushima, PhD (dem2159)

Activities

Pathway to Independence



Other short term training: Career Development (POR Colloquium)
Methods in Minutes
Team Science BIRM (Building Interdisciplinary Research Models)

Submitting a R01 for the February 5th deadline and need editing services?

VP&S Office for Research offers editing services for ESI faculty.



In this pilot phase, priority is given to VP&S assistant professors in basic science departments and the Irving Institute's Reach for the R01 Program.

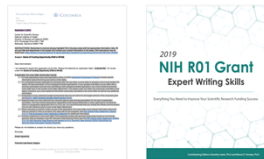
For more information visit www.ps.columbia.edu/esi-editing-service

To sign-up, email Danielle Matsushima, PhD (dem2159)

Other helpful resources...

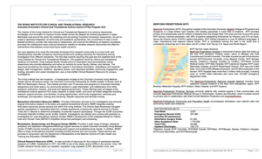
Grant Starter Kit

- Checklists
- Templates
- Examples of attachments
- Helpful links



Facilities & Resources Bank

- Descriptions of:
- Institutional resources
 - Departments
 - School offices
 - Core facilities



BioRender

Easy way to create scientific figures for presentations, grants, and papers



www.ps.columbia.edu/grant-toolbox

www.ps.columbia.edu/biorender

← Back to Columbia University Mailman School of Public Health Search Mailman

COLUMBIA MAILMAN SCHOOL OF PUBLIC HEALTH

Information For Faculty & Staff

Faculty & Staff Research Resources (R2)

Teaching & Learning School Directory Administrative Offices **Research Resources (R2)** Toolkit HR/Benefits

Research Resources (R2)

About Us

In 2013, leadership of the Research Resources Office was taken over by Dr. Pam Factor-Litvak, Associate Dean for Research Resources and Professor of [Epidemiology](#). The Research Resources (R2) Office supports Mailman School researchers in the development and preparation of grant applications. The office helps researchers identify appropriate funding opportunities, develop project ideas, organize, edit and prepare grant applications, and arranges for internal review and feedback on applications prior to submission. R2 also provides training in grantsmanship, research management, and professional development-related issues.

This website section provides access to grant-related resources that include:

- Templates and guidance documents for grant proposal preparation
- A library of sample grants and sample grant components
- Updates on current research-related news
- Information about current and future funding opportunities

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Significance

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