HARVARD
School of Dental Medicine

2023-2024 DMD RESEARCH GUIDEBOOK

Introduction to HSDM Research

By leveraging its scientific strengths and focusing on the areas of skeletal biology and the pathology of bones, joints, vascular and connective tissues, as well as clinical, health policy, and global health research, HSDM has established a strategic direction for its research programs. As the only School within Harvard University with its own clinical facility, HSDM continues to differentiate itself through a unique emphasis on basic and clinical research combined with exemplary patient care and education. The main goal of performing a scholarly project is to educate a new generation of clinician-scholar minds and to ensure that high quality dental health and dental medical research is undertaken and translated to patient care. All DMD students at HSDM must complete a scholarly project and present this work at HSDM Student Research Day as part of their graduation requirement. The Office of Research provides guidance and will support students as they fulfill their research requirements.

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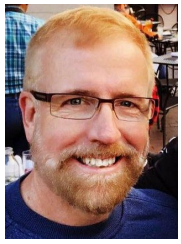

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Research Requirements

HSDM students can find many opportunities to perform their scholarly project, from research in the basic and clinical sciences to studies in global and community health and dental education. Faculty at HSDM and HMS-based labs and affiliated hospitals all offer opportunities for HSDM students. Students also find research opportunities across the US and abroad. While some students identify a mentor/project in their first year, majority of students will identify a mentor and start a project during their second year and will continue to carry out the project during their third or fourth year.

1. Select a ***Research Track***
2. Identify a ***Research Mentor***
3. Identify a ***Research Project***
4. If required, obtain ***IRB/IACUC Approval***
4. Complete the ***Research Notebook*** from year 2 to year 4
5. Complete ***Research Project***
7. Submit ***Abstract*** for HSDM Student Research Day.
8. Present ***Poster*** at HSDM Student Research Day.
9. Not required but strongly recommended: **submit and publish your manuscript(s)**

Selecting A Research Track

All DMD students at HSDM must complete a scholarly project and present this work at HSDM Student Research Day as part of their graduation requirement. Students will be introduced to research activities at HSDM and will be asked to choose the ***Research Track***, or ***Global and Community Health Track***. The form for selecting a track is found at the end of this Guidebook.

Research Track
The "Research Track" will expose students to basic or clinical/translational research. Basic research or bench research aims to improve human health with scientific discoveries. Such discoveries typically begin at "the bench" with basic research — in which scientists study disease at a molecular or cellular level. This may include the use of animal models such as mice, chicks, and zebrafish. Basic scientists provide clinicians with new tools for use in patients and for assessment of their impact. Clinical/translational research aims to improve human health by translating scientific discoveries into practical applications that progress to the clinical level, or the patient's "bedside." Scientists are increasingly aware that this bench-to-bedside approach to translational research is really a two-way street. Clinical researchers make novel observations about the nature and progression of disease that often stimulate basic investigations.

Global and Community Health Track
The "Global and Community Health Track" overseen by the Office of Global and Community Health, will expose students to public health and health services projects with a focus on health promotion, access to care, disease prevention, pharmacological and behavioral interventions, epidemiology of dental diseases, and health care policy. Your research project in global and community health may include rotations through community health care settings to provide you with the tools necessary to become a leader in global and community health.

Identify A Research Mentor

The importance of mentor and project selection should not be overlooked; they are crucial to the quality of your experience and the successful completion of your requirements. Thus, you should expect to devote a considerable amount of time to this step, critically assessing the research environment offered by the mentor. Clearly, you should find the proposed project interesting and important. Beyond that, it is essential that the specific aims of the project be clearly delineated and feasible within the available timeframe. The mentor should have the resources

to enable you to achieve the specific aims. If your project involves human subjects, you should ask whether the mentor has obtained the necessary IRB approval. If the mentor has not obtained approval, you should plan for additional time so that the mentor can obtain such approval. Ideally, a mentor will have demonstrated productivity by a record of publication and a record of private or public funding in a given area. A mentor does not have to be in the field of dentistry. **Dr. Francesca Gori (Francesca_gori@hsdm.harvard.edu) and the Office of Research are great resources for guiding students. In addition, the Scholarship in Oral Health (SOH) class in the second year is designed to help you to identify a mentor/project in your field of interest. The most comprehensive database for Faculty mentors is on the Harvard Catalyst website: http://connects.catalyst.harvard.edu/Profiles/SearchProfiles.aspx.**

Identify a Research Project

DMD students have chosen projects in all areas of basic, clinical, translational, public health, global health and epidemiological research. Students have chosen research mentors at HSDM and the Forsyth Institute as well as throughout the Longwood Medical Area and beyond. The Office of Research maintains databases of DMD student projects and mentors if you need additional information.
Below are just a few examples of projects DMD students have worked on.

The role of Ddr2 in the articular cartilage degeneration of TMJs originated by a partial discectomy of TMJ disc (Yefu Li)
A 10-year retrospective radiographic study of implantium dental implants (David Kim)
The diagnostic accuracy of incisional biopsy in the oral cavity (Meredith August)
Dental hygienist-led chronic disease management system to control early childhood caries (Man-Wei Ng)
Impact on junior faculty of teaching opportunities during predoctoral education (Sang Park)
VEGF stimulates intramembranous bone formation during craniofacial skeletal development (Bjorn Olsen)
What Is important for confirming negative margins when resecting mandibular ameloblastomas? (Zachary Peacock)
Candidal carriage predicts candidiasis during topical immunosuppressive therapy (Sook-Bin Woo)
Vaccine hesitancy and online information: The influence of digital networks (Brittany Seymour)
A vibration device to control injection discomfort (Jeffry Shaefer)
Assessing the accuracy of computer color matching with a new dental porcelain shade system (Shigemi Nagai)

Obtain/be added to an IRB/IACUC Approval

HSDM students are subject to the same policies, guidelines and regulations as the Faculty of Medicine. It is therefore necessary for student research projects to be reviewed by the Office of Research Subject Protection. The Committee on Human Studies has an Internal Review Board and reviews all human subject-related research projects. The Standing Committee on Animals has an Institutional Animal Care and Use Committee and reviews all animal subject-related research projects. It is important to note, it is HSDM's policy that students should not submit their own application, but instead, work with their Research Mentor under his/her application. Information on HMS/HSDM IRB and IACUC training, requirements, and approvals, and all relevant documents, can be found on the website of the HMS Office for Research Subject protection, http://www.hms.harvard.edu/orsp/index.html. Students are required to obtain all appropriate HMS/HSDM institutional and site approvals (domestic or international) before commencing research activities. If you have a question about whether your research even needs an IRB review, contact them. They can be reached at orsp@hms.harvard.edu; 617-432-3071. Dr. Shigemi Nagai (shighemi_nagano@hsdm.harvard.edu) and Dr. Francesca Gori (Francesca_gori@hsdm.harvard.edu) are excellent resources for IRB/IACUC questions and troubleshooting.

Complete the Research Notebook

All students are required to complete the Research Notebook (on Canvas) starting on Year 2 and will continue to do so until Year 4

Year 2

September 15, 2023 – Third week of December, 2023: By Monthly Assignment. Due on Friday by 5:00pm

Student will be required to respond to the following questions:
1) Write one or two sentences describing what you have accomplished for you research requirement 2) Describe any challenge you might have encountered and how Faculty can help you.

Assignment due on the second Monday of January 2024 by 5:00pm

Student will be required to write a 2-3 pages (single space,12 Arial font) summary/narrative of the 3 week-research time. This should include but should not be limited to: a) name the mentor/lab/clinic you have chosen to perform your project, b) a summary of the overall goal of your project and your role in the project c) your progress and accomplishments and plans for the upcoming months and d) any challenge you have encountered.

January -July 1st: Monthly Assignment. Due last Friday of the month by 5:00pm

Student will be required to report the progress of their scholarly project. (1 page (400-500 words), single space, 12 Arial font)

Year 3 and Year 4

Monthly Assignment. Due last Friday of the month by 5:00pm
Student will be required to report the progress of their scholarly project. (1 page (400-500 words), single space, 12 Arial font)

Submit Abstract for the annual HSDM Student Research Day

All students presenting a poster at Research Day must submit an abstract (500 words maximum) of their research to the Office of Research for inclusion in an abstract book. A sample may be found at the end of this Guidebook. Your abstract should include brief sections that clearly and concisely describe:

- *Significance and background of the study*
- *Innovation*
- *Approach (experimental design, expected outcomes and interpretation)*
- *Results*
- *Conclusions*

Present Poster at the annual HSDM Student Research Day

Student Research Day at Harvard School of Dental Medicine is an annual event held each April. The primary focus of this all-day event is for graduating DMD, MMSc, DMSc, and PhD students to showcase their research to faculty as well as fellow students at Harvard School of Dental Medicine, The Forsyth Institute and Harvard Medical School. Graduating students present an electronic research poster to faculty who in turn, evaluate their work. The Office of Research awards “best poster” certificates for each student group. E-Poster guidelines and a sample will be circulated in February 2021. Faculty and Postdoctoral Fellow reviewers look at six criteria when evaluating posters:

-Student’s ability to describe the work and its significance;
-Organization and clarity of the poster presentation;
-Introduction and formulation of hypothesis and scientific method;
-Quality and extent of work done by the student;
-Student’s overall understanding of the project; and
-Overall evaluation of the poster and presentation.

Honors in Research

Overview

The Honors in Research provides students the opportunity to earn their DMD Degree with Honors in Research. Honors projects must be worked on throughout all 4 years, completed by the end of your fourth year and require the submission of a thesis and its defense. All students recommended for Honors in Research are required to write and submit a 10-page, single-spaced research report describing their research experience, or a scientific manuscript. Students may pursue Honors in any research discipline. Students can apply to be considered for Honors in Research in their 3rd and/or 4th year. However, students defend their honors in research Thesis in their 4th year. The DMD Honors in Research committee evaluates the application and make a recommendation. Starting in February of the 4th year, students submit their honors theses. Students defend their thesis in April of their 4th year. Students are notified prior to graduation. An "Honors thesis" builds on a scholarly project that students have conducted during their enrollment at HSDM. Thesis preparation can require a significant commitment of your time and effort, as well as considerable input from your faculty mentor and other faculty members. ***Do not submit a Statement of Intent unless you complete and submit a thesis***.

DMD Honors in Research Committee

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Shigemi Nagai, DDS, PhD, *Associate Professor of Restorative Dentistry and Biomaterials Sciences*
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Expectations and criteria for Honors in Research

Students are required to be involved in a scholarly project in any research discipline, from research in the basic and clinical sciences to studies in global and community health and dental education. Therefore, it is important to clarify the expectations and criteria to determine whether a student's work achieves honors and to distinguish a scholarly project from a project deserving Honors in Research. An "Honors thesis" builds on a scholarly project that students have conducted during their enrollment at HSDM, requires a significant commitment of the student time, effort and involvement in the planning. Therefore, the Honors thesis should exceed the threshold required for scholarly projects in its significance, impact, and research effort.
An ideal Honors project should be a rewarding, significant, intellectual, and creative effort that:
1. Reflects the commitment and contribution of the students to the design, execution and analysis of the data generated
2. Reflects the intellectual interests of the students
3. Adds value to the students and to the field of research
4. Challenges the students
5. Teaches critical thinking, skills, communication, and knowledge in the field
6. Leads to an intellectual growth

Application Process:

4th year Students

Statement of Intent

The following documents must be submitted as ONE PDF document to Zach Tuomey, Zachary_Tuomey@hsdm.harvard.edu

1. Mentor letter of recommendation and approval to be considered for Honors in Research
2. A resume or CV
3. Two pages describing the scholarly project and the contribution to the project
4. A list of four HSDM faculty who may be invited to serve as an examiner

Deadlines

Statement of Intent: November 1 of your 4th year
DMD Honors in Research Committee make a recommendation: December 15 of your fourth year
Honors Thesis Submission: From February 1st to April 1st of your 4th year
Honors in Research Defense: Spring of your 4th year (before April 20)

3rd year Students

Statement of Intent

The following documents must be submitted as ONE PDF document to Zach Tuomey, Zachary_Tuomey@hsdm.harvard.edu

1. Mentor letter of recommendation and approval to be considered for Honors in Research
2. A resume or CV
3. Two pages describing the scholarly project pursued and the contribution to the project
4. Investigations and contributions planned for year 4.

The DMD Honors in Research committee will evaluate the application and make a recommendation in the Spring semester. If recommended for Honor in Research, students will NOT defend their thesis in Year 3.
NOTE: Students will apply again for Honor in Research in Year 4 following the guidelines described below.

Deadlines

Statement of Intent: November 1 of your 3rd year
DMD Honors in Research Committee make a recommendation: 3rd year Spring Semester
New Statement of Intent*: October 15 of your 4th year
DMD Honors in Research Committee make a recommendation: December 15 of your 4th year
Honors Thesis Submission: From February 1st to April 1st of your 4th year
Honors in Research Defense: Spring of your 4th year (before April 20)

*includes:

1. Mentor letter of recommendation and approval to be considered for Honors in Research
2. A resume or CV
3. Two pages describing your progress in the scholarly project
4. A list of four HSDM faculty who may be invited to serve as an examiner

Please note:

1) The Committee will provide the students applying in their third year with a formal letter stating that they will be considered in their 4th year to receive a DMD degree with Honor in Research.
2) The Research project proposed for Honors in Research in year 3 cannot be changed
3) Be considered for Honors in Research in the third year does not guarantee that students will graduate with Honors in Research.

Submission of Honors Thesis

Submit your honor thesis as a PDF to Zach Tuomey, Zachary_Tuomey@hsdm.harvard.edu

Your thesis should be not more than 10 pages long excluding References (single space, 11 or 12 font size) and should be organized as follow:

ABSTRACT: In 500 words or less, summarize your project.

INTRODUCTION: Significance, Hypothesis, and Background. This section should review the pertinent literature and outline the major scope of the research. Reference should be made to previous relevant studies in order to explain what has been done as well as to explain the purpose of this research. This section should include a succinct articulation of the hypothesis tested.

APPROACH: Experimental Design, Expected Outcomes, and Interpretation. Describe clearly and carefully the procedures and materials used; a reader should be able to repeat your exact methodology. This section should also include statistical methods.

RESULTS AND DISCUSSION: Report the results in a well-organized fashion tables and Figures. Table and Figures need to have a legend.

CONCLUSION AND FUTURE DIRECTION: The data should be explained and interpreted with reference to the previous literature. The significance of the results needs to be included. This is the section in which to emphasize subjective comment. In a thesis, the scope of the discussion extends beyond that of a journal article. For example, you may discuss why your first experiments failed, or how you arrived at the design for a particular protocol, or what you would do next if you were continuing the study.

REFERENCES: References must be numbered consecutively as they are cited.

Honors Thesis Defense

Honors Thesis defense should last approximately 60 minutes.

1. Thesis defense with examiners and DMD Honors in Research Committee*
   - **Presentation:** You will begin the exam by presenting a 30-minute overview of your research as a power point presentation
   - **Questions and discussion** (30 minutes): The examiners will ask questions that may cover thesis content, the general thesis research field, or methods, including statistical analysis, instrumentation, and materials. You should be able think on your feet, acknowledge the limitations of your work, and relate it to the larger research field.
2. DMD Honors in Research Committee deliberations: The examiners will discuss your thesis and examination. Decisions regarding Honors are made after all the Honors theses have been presented.
3. Successful candidates will be notified in May prior to graduation and will receive the DMD Degree with Honors in Research.

** Two experts in the student's research field who are assistant professors or above and 2 members of the DMD Honors in Research Committee. A representative of your academic society and your mentor may also be present.*

Additional Research Information & Forms

ACADEMIC, PROFESSIONAL, AND SCIENTIFIC CONDUCT:

PREPARATION OF PAPERS AND OTHER WORK

All homework assignments, projects, lab reports, papers and examinations submitted for a course are expected to be the student's own work. Students should always take great care to distinguish their own ideas and knowledge from information derived from other sources. The term "sources" includes not only published or electronic primary and secondary material, but also information and opinions gained directly from other people. It is each student's responsibility to understand the expectations of academic integrity, proper forms of citation, and submission of one's own work. In addition, collaboration in the completion of assignments is prohibited unless explicitly permitted by the instructor, in which case it must be acknowledged.

AUTHORSHIP GUIDELINES

Authorship is an explicit way of assigning responsibility and giving credit for intellectual work. The two are linked. Authorship practices should be judged by how honestly they reflect actual contributions to the final product. Authorship is important to the reputation, academic promotion, and grant support of the individuals involved, as well as to the strength and reputation of their institution. The Faculty Council of Harvard Medical School has endorsed the following statement. Although authorship practices differ from one setting to another, and individual situations often require judgment, variation in practices should be within these basic guidelines.

- *Everyone who is listed as an author should have made a substantial, direct, intellectual contribution to the work. For example (in the case of a research report) they should have contributed to the conception, design, analysis and/or interpretation of data. Honorary or guest authorship is not acceptable. Acquisition of funding and provision of technical services, patients, or materials, while they may be essential to the work, are not in themselves sufficient contributions to justify authorship.*
- *Everyone who has made substantial intellectual contributions to the work should be an author. Everyone who has made other substantial contributions should be acknowledged.*
- *When research is done by teams whose members are highly specialized, individual's contributions and responsibility may be limited to specific aspects of the work.*
- *All authors should participate in writing the manuscript by reviewing drafts and approving the final version.*
- *One author should take primary responsibility for the work as a whole even if he or she does not have an in-depth understanding of every part of the work.*

RESEARCH RESOURCES:

CORE RESEARCH FACILITIES

The Harvard Catalyst core facilities database is powered by the eagle-i network and is searchable by category, institution, or keyword https://cores.catalyst.harvard.edu. Please contact Jim McBride, Director of Core Labs at HSDM, if you are interested in learning more about our facilities or have questions regarding facilities, equipment, or training. It is important to note that you must be trained to use equipment and access laboratories at HSDM.

SUBMITTING A GRANT APPLICATION

If you do plan on submitting a grant application, please work with the Office of Administration and Finance. They must be notified prior to the submission deadline. All grant applications must be approved through the Office of Administration and Finance as well as your Research Mentor prior to submission. This pertains to all funding (including but not limited to government awards, foundation awards, dental society awards) even if they do not require institutional approval. If you have any questions about this policy, please speak with Meghan O'Donnell, (Meghan_ODonnell@hsdm.harvard.edu).

POSTER PRINTING

If you present a research poster at a national or international conference, then you are eligible for poster printing through the Office of Research. The Office of Research has an account at www.phdposters.com. From this link, click orange tab "Start you order now" then under the three orange tabs, you will see a link "or use a PhD Posters group account," click here and then log in **HSDM**; password **HSDMResearch**.

SAMPLE RESEARCH DAY ABSTRACT

A Longitudinal Study of Ovarian Morphology in Healthy Ovulatory Women

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Polycystic ovary syndrome (PCOS) affects 5-7% of reproductive aged women. Though its phenotypic expression is variable, PCOS is also associated with infertility, insulin resistance, obesity, cardiovascular risk factors, and endometrial cancer. PCOS is diagnosed using two of three clinical criteria: menstrual dysfunction, hyperandrogenism, and/or polycystic ovarian morphology on ultrasound. Polycystic ovarian morphology (PCOM) is defined as increased ovarian volume or ≥ 12 follicles/ovary.

PCOM on ultrasound is almost universal in women with PCOS. However, PCOM is also found in 16-25% of apparently normal, regularly cycling women. Normally cycling women with PCOM have been shown to have higher androgen and fasting insulin, and lower SHBG levels than women with normal ovarian morphology. Though these levels were still within normal ranges, they reflect trends toward the hormonal abnormalities seen in PCOS.

Based on these hormonal differences, we hypothesized that women with PCOM have an increased propensity to develop PCOS over time compared to women with normal ovarian morphology. To test these hypotheses, women with regular menstrual cycles and normal or polycystic ovary morphology on ultrasound were studied (n=38) 1.7-18.3 years after a previous ultrasound (mean±SD, 8.61±5.1 years). Subjects underwent a repeat ovarian ultrasound, interval menstrual history, physical exam, and measurement of gonadotropin, androgen and metabolic hormone levels in the early follicular phase.

At the first visit, twenty-three women (60.5%) had PCOM and fifteen (39.5%) had normal ovarian morphology. Among women who had PCOM at previous visit, twelve maintained PCOM and eleven converted to normal morphology at the second visit. In subjects that converted to normal morphology, there was a greater decrease in testosterone from the first to second visit than in those that maintained PCOM (-25.1±10.2 vs. 2.3±4.5 ng/mL; $p<0.05$). One subject with PCOM developed irregular menses during the interval. Among women with normal ovarian morphology at previous visit, two developed PCOM (13.3%), and thirteen maintained normal ovarian morphology. There was no obvious difference in weight, androgens, or metabolic parameters in the two subjects who developed PCOM.

These data indicate that PCOM in women with regular cycles does not appear to confer increased risk for the development of PCOS. Approximately half of women with PCOM convert to normal ovarian morphology with aging, and this conversion is associated with a greater decrease in testosterone over time. These data also show that in women with regular cycles, it is not common to develop PCOM if the ovaries are normal on first assessment.