



**Yale University
School of Medicine**

Medical Student Research Program

and the

Yale M.D. Thesis Requirement



Guide for Students and Faculty Sponsors

**Prepared by
The Office of Student Research
October 2015**

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1. HISTORY OF STUDENT RESEARCH AT YALE UNIVERSITY SCHOOL OF MEDICINE

The presentation of a dissertation has been one of the requirements for the degree of Doctor of Medicine at Yale for over 176 years. Initially, case reports and reviews of literature predominated, but as the scientific method was established in medicine, the faculty required that dissertations presented be based on original investigation either in the laboratory or in the clinic. This experience is considered an important and essential phase of a curriculum which is designed to promote the development of critical judgment, habits of self-education, imagination and scholarship, as well as the acquisition of knowledge and research skills.

The first evidence that the thesis or dissertation was considered a requirement for the degree of Doctor of Medicine is in a statement in the catalog from 1839, which in part reads, "...the candidate must present a dissertation on some subject connected with the medical sciences." This requirement remains in effect to the present time, and is enthusiastically endorsed by the faculty as a central component of the "Yale System" of general medical education.

The creative discipline required to carry out a project and prepare a thesis enables each student to become a physician-scholar, whether the ultimate objective is research, education, clinical practice or administration. Yale hopes to produce physicians who can evaluate data quickly and critically as they must do throughout their professional careers.

The M.D. thesis at Yale University teaches a student how to understand the scientific method from the inside, how to specify a clear research question, how to collect and evaluate data and communicate the knowledge to others, and how to think scientifically and critically for the rest of his/her professional life.

To this day, the Yale University School of Medicine has carried on the tradition of required medical student research. This tradition is a hallmark of the Yale system of medical education.

2. MEDICAL STUDENT RESEARCH PROGRAM AT YALE

a. Overview

All students at Yale University School of Medicine engage in research and are required to write an M.D. thesis during medical school, with the exception of students who have a Ph.D. degree in the biological sciences before matriculation. A wide choice of subjects for research is permitted. Students may choose basic laboratory projects or clinical projects or may select to do research in an array of disciplines including, but not limited to: epidemiological, humanities and medicine (including ethics and the history of medicine), sociology, economics, or education research. Publications in the literature may serve as the source of data for research. Four basic requirements apply to all thesis research projects: (1) the subject chosen must address an important question in medicine; (2) there must be a clear, concise aim that can be addressed by new knowledge generated by the student's research; (3) data must be collected and analyzed with the most rigorous methods suited to the research question; and (4) the research mentor must be a full-time faculty member at the School of Medicine.

A close working relationship between the student and faculty research mentor is a major goal of this program and is strongly encouraged. When laboratory research is performed, it is the responsibility of the faculty advisor to provide all necessary space, equipment and supplies, including costs of publication. For non-laboratory investigation, the same commitment to guidance and support is expected, e.g. access to data, statistical analysis packages, statistical and methodological support, costs of abstracts and publications, etc. Weekly conferences between student and advisor are encouraged during the course of the research. The research must be designed and specifically performed by the student with the advice of the faculty mentor. Students may not work jointly on a research project.

The research is presented as a formal bound thesis during the fourth year or graduation year and must fulfill the following minimal requirements (see page 26 for exact details):

- a. Title Page
- b. Summary (in abstract form)
- c. A critical review and citation of the work of previous investigators
- d. Valid research design
- e. Evidence of mastery of appropriate methodology, including a detailed description of what was done by the student and what was done by others. Please see details on page 26.
- f. Presentation and analysis of research data, including figures and tables
- g. Conclusions that are supported by the data
- h. A literate presentation
- i. Complete bibliography with full citations

Before the written report is presented to the Office of Student Research and the Thesis Committee, it must be approved in writing by the student's advisor and by a Thesis Review Committee in the department where the work was performed.

The Thesis Committee acting as a Thesis Awards Committee, reads, critiques and ranks all student theses submitted for honors by various departments and votes a score. The highest ranked papers are presented orally at Student Research Day, chaired by the Dean of the School. Most theses are presented as posters at Student Research Day in May which is widely attended by students and faculty. Thirteen prizes are awarded at graduation for outstanding student

research. Prizes are not announced until graduation.

b. Time and Funding Available for Research

Practically ALL students begin research work during the summer following their first year. For example, during the summer of 2015, 84 (of 86) first year medical students remained in New Haven to work with faculty members on a wide variety of projects. Many students continue their research work in the afternoons, evening and weekends during the second year of medical school. Additional three month blocks are available in the last half of the third year and in the fourth year. Thus, a total of six to nine months is currently available for research by each Yale student during their four years at medical school. **A reminder:** Data collection can take many months. Additional time is then needed for data analysis, thesis (or manuscript) preparation, submission, and revision (in the case of manuscripts accepted for publication). Stipends are available to support summer research and all other periods when full-time research is performed. Financial support is not provided for writing the thesis.

Students are discouraged from beginning their thesis work at another institution during the summer between the first and second year. Students who conduct research the summer after their first year at another institution are responsible for securing funding from the other institution. If there is a planned collaboration between the student, the Yale faculty sponsor and the faculty at the other institution (for example, shared reagents, shared database or patients, continuation of the project at Yale) then a maximum of 50% funding may be provided by the Office of Student Research if the project is approved. This funding restriction does not apply to research carried out at another institution after the summer of the first year.

c. Elements of the Yale Curriculum Favorable for Student Research

The Yale medical curriculum provides an ideal milieu for encouraging research training at the student level because the curriculum:

1. There is a high student/faculty ration with only 100 students per class.
2. Fosters a non-competitive environment through unsigned examinations in basic science courses.
3. There is an emphasis on research, scholarship, and critical thinking, culminating in the required medical student thesis for graduation.
4. Contains fewer scheduled class lectures than many other medical schools in the United States.

Thus, there is substantial time available for training and independent research by students. There is an established tradition for faculty to encourage students as colleagues in a community of scientists. Finally, Yale Medical School recruits an outstanding body of students who at the time of matriculation are aware of the requirements and expectations for creative scholarly work. This system has spawned a large number of eminent M.D. investigators.

3. GETTING STARTED

a. Resources Available

A list of faculty members and their areas of research is available on-line in the World Wide Web and is provided in hardcopy to each student. To access the faculty research information use a search engine and open the URL and type **<http://medicine.yale.edu/education/osr/index.aspx>**. A pdf copy of the Faculty Research Directory is available under Useful Information. You may search by keywords or by individuals listed in each department.

Dr. Forrest, Director of the Office of Student Research, is available to discuss options with individual students by appointment. After deciding upon the area of general interest, the student should interview with members of the faculty who are working in that field. After appropriate discussions with several potential mentors and others working in their group, and visits to lab or research group meetings, the student should choose the faculty member with whom he/she wishes to work. The faculty member should make every effort to orient the student to a practical problem that can be fulfilled within the available time. Although it is not necessary that the idea for the thesis originate with the student, it is necessary that the work be his/her own. The student can work as a member of a group project only if the student's contribution is carried out on an independent basis. Dissertations written jointly by two or more students are not acceptable.

Most Yale M.D. theses average 40-80 pages of text. A minimum of 30 pages of text excluding figures, legends and references is required (see page 26).

Publications. The primary goals of the thesis are to engage and expose the student to the full research endeavor: asking an important question; specifying clear, answerable aims; applying appropriate methods and techniques to data collection and analysis; and documenting the work in writing. Although a publication is not required, it is greatly encouraged and a wonderful opportunity for the student to share their work with the larger scientific community. The student should write the first draft and expect to be first author on the manuscript. Papers can be published at any time and are independent of the MD Thesis.

b. Specifying Clear Aims

Excellent research begins with an excellent research question. Specifying clear answerable aims and an hypothesis where possible, informs the selection of the appropriate methods and techniques necessary to conduct the research. Ideally, the research question and specific aims should be original and important and should generate substantial interest by leading investigators in the field. It is not excellent research to answer a research question which is highly predictable or expected or in which there will be little national medical interest. Developing an answerable research question and specifying clear aims should begin with a literature review and by speaking with your mentor and other experts in the field. A review of the literature (meta-analysis) or review of patients' charts may be the source of data used for a thesis. However, the basic requirements still apply. There must be an important research question with specific aims that can be illuminated by the student's work.

c. Literature Review, Protocol Formulation, and Application for Funding

When the area of investigation has been agreed on by the faculty preceptor the student is expected to explore the literature and formulate a protocol. This step provides an unusual opportunity for tutorial instruction in experimental design. Faculty members who assume responsibility as preceptors should provide the amount of guidance that is necessary in design of the investigation. The final protocol and application for funding should then be reviewed and approved by the faculty advisor and then by the Department Thesis Chairperson.

d. Statistical Analysis

When the results of an investigation lend themselves to statistical analysis, the student should be encouraged to seek the aid of a biostatistician for assistance in statistical methodology. It is hoped that this will enable the student to learn the value and limitations of statistical analysis as an aid to interpreting the results of an investigation. See the list of Secondary Thesis Advisors for clinical epidemiology and clinical research methods. See also page 18, Computer facilities for statistical analysis.

e. Research Involving Human Subjects

All research involving human subjects must be approved by the Human Research Protection Program formally known as Human Investigation Committee of the School of Medicine. Applications and guidelines are available online at the Human Investigation website at <http://www.yale.edu/hrpp/>

f. Joint Projects Not Acceptable

Dissertations written jointly by two or more students are not acceptable. This does not mean that they may not work on related problems, but each student should have the experience of carrying out an investigation from beginning to end on his/her own initiative.

g. Research Done Outside of the Yale Medical School

First-year students considering research at another institution

Research at another institution is clearly discouraged in the summer of the first year.

The reasons for this are as follows:

(1) Starting a project that has a high likelihood of being used for the thesis with a Yale faculty mentor is important. If you are working at Yale, you have ready access either to the laboratory or the study population and the mentor with whom you are working.

(2) Funding in the summer of the first year comes predominantly from training grants and Yale funds that require that the work to be done at Yale.

(3) Working at Yale ensures that the student will receive excellent training in conducting research since the Yale faculty member knows the Yale MD thesis system and the responsibilities of the mentor.

For these reasons students are advised to begin their work at Yale with a Yale advisor in the summer of the first year.

If you decide to do research at another institution (non-Yale site for example, Harvard, Columbia, Stanford, etc.) you are responsible for obtaining your funding. You should be certain to have a Yale sponsor before you complete the arrangements at the other school because this Yale faculty sponsor will need to approve your application for partial funding (if allowed) and will give advice if this work is ultimately used for your thesis and will have the thesis reviewed in his or her department at Yale.

The above does not apply for research done after the first year.

Concerning your responsibility for funding if work is done at another institution in the summer of the first year:

(1) The responsibility for funding is yours.

(2) If there is a significant connection of the work to the Yale faculty sponsor, i.e. if you are using reagents from the Yale lab, if you are using study populations at Yale as well as the other institution, if you plan to continue the work in the Yale advisor's group when you return to Yale etc. then it is possible to obtain half funding from Yale. This is the maximum funding that can be obtained if there is a legitimate connection to the Yale sponsor. If the Yale sponsor is serving as a passive conduit and is not taking an active role in examining the proposal, making suggestions, etc. then the student alone is responsible for obtaining complete funding generally from the other institution or from a national organization.

Obtaining funding from another institution:

Frequently, if the investigator at another institution is well funded they will readily fund all or half of your application. If they are not willing to do so you should reconsider this choice. The Office of Student Research is willing to make one phone call to the P.I. at the outside institution to encourage them to provide full or partial funding. This is sometimes successful and sometimes not. Students should recognize that it is preferable to begin the work at Yale when research is begun in the summer of the first year.

Research at an outside institution done after the first year:

Students performing research at another institution other than the summer of the first year can receive full funding from the Office of Student Research if the following requirements are met:

(1) The application for funding for full-time research is approved a Yale faculty sponsor who will be responsible for reviewing the thesis and submitting the work in their department.

(2) This applies to both short-term funding and one-year medical student research fellowships, which also can be done at other institutions for some pullout fifth year programs (Sarnoff, Howard Hughes and institutions that have Doris Duke programs).

Second-year and beyond considering research at another institution:

A student may wish to undertake his/her research project under the supervision of a qualified full-time investigator who is not a member of the faculty of Yale University School of Medicine. **The approval of an outside preceptor will be granted by the Office of Student Research upon receipt of a statement by a full time Yale faculty member acting as sponsor and mentor, in whose area the research work will be done.** The statement should indicate the Yale mentor has approved the preceptor and the facilities available for the research project. The same regulations concerning the dates of submission and review by the appropriate departmental committee will apply to the thesis done outside of the medical school. Specifically, the faculty member will be responsible for reviewing the progress of the thesis with the student, reviewing the written thesis and giving faculty approval. The thesis will be reviewed by the Department Thesis Committee of this faculty member's department.

h. Ph.D. Thesis in Lieu of Medical School (M.D.) Thesis

For students enrolled in the combined M.D./Ph.D. Program, the doctoral thesis submitted to and approved by the Graduate School will serve in lieu of the thesis requirement of the Medical School. The Graduate School awards degrees twice a year, in late fall (November or December, depending on the Corporation schedule) and May. In order to guarantee consideration by the appropriate Graduate School Committee on Degrees, the dissertation must be submitted by October 1 for a fall degree, or March 15 for a May degree. **Students planning to submit the dissertation on March 15 for a May degree, however, should make every effort to file the petition by mid-February, so that planning for commencement ceremonies can proceed in a timely fashion. If the Ph.D. has not been completed, a separate M.D. thesis must be submitted to qualify for the M.D. degree.**

i. Applied Principles of Clinical Research

Several years ago, at the recommendation of students, Yale Medical School established a requirement for all students carrying out thesis work in clinical research areas, including those graduating in four years, which is participation in the Applied Principles of Clinical Research Sessions in July and August each summer. The NIH now also requires these sessions.

Students have found these sessions to be extremely useful and have encouraged their continuation. Instructors will use examples from your applications for summer research support. It is strongly recommended and required that you attend these sessions to aid you in the design and execution of your planned summer research, and your eventual thesis work. On the following three pages is the syllabus.

Summer 2015

Location: See Discussion Sections below for room locations

The purpose of this intensive two-week course is to provide an overview of the objectives, research strategies, and methods of conducting patient-oriented research. Emphasis is placed on applying concepts to students' actual research projects. Sessions are workshops that combine didactics and use students' projects to illuminate concepts. Participation is critical to the success of this seminar.

Seminar Leaders, Sections, Contact Information:

Karen Dorsey, MD, PhD

Nancy Kim, MD, PhD

Marcellz Nunez-Smith, MD, MHS

Assistant Professor, Pediatrics

Assistant Professor, GIM

Associate Professor, GIM

Administrative Assistance in the Office of Student Research:Donna Carranzo, donna.carranzo@yale.eduMae Geter, mae.geter@yale.eduKelly Jo Carlson, kellyjo.carlson@yale.edu

	DISCUSSION SECTIONS	CONTACT INFORMATION
Karen Dorsey	Session 1: 7/7 - 7/10: 12:00 - 1:30 pm 7/13 - 7/16: 12:00 - 1:30 pm Session 2: 7/7 - 7/10: 1:30 - 3:00 pm 7/13 - 7/16: 1:30 - 3:00 pm Location: The Anylan Center (TAC) Room N209, 300 Cedar St.	(203) 737-9227 karen.dorsey@yale.edu
Nancy Kim	Session 2: 7/7 - 7/10: 9:00 - 10:30 am 7/13 - 7/16: 12:00 - 1:30 pm Location: The Anylan Center (TAC) Room N211, 300 Cedar St.	(203) 764-5675 nancy.kim@yale.edu
Marcella Nunez-Smith	Session 3: 7/14 - 7/17: 1:00 - 2:30 pm 7/20 - 7/21: 12:00 - 1:30 pm 7/22 - 7/23: 1:00 - 2:30 pm Location: Harkness Mezzanine	(203) 785-6454 marcella.nunez-smith@yale.edu

Office Hours:

To make an appointment, please send an e-mail with the issue that you would like to discuss and the times that you are available within a 1-2 week period; We will schedule a meeting as quickly as possible. If you have any questions or need additional information, please do not hesitate to contact us.

Readings (before class):

Readings include articles and text chapters. The readings provide a broad overview of topics for students with diverse interests. Materials will be available in class and posted on Blackboard.

Recommended texts:

Stephen Hulley, Designing Clinical Research
Lange, Basic Clinical Biostatistics

Attendance:

Students are expected to attend all tutorials in their own section.

If you are unable to attend any section during a given week you can complete a make-up assignment. This can only be done once during the summer session.

In order to receive credit for the course students must attend or receive credit for at least 6/8 sessions.

Learning Objectives

After completing the assignments the students will be able to:

- discuss the fundamental principles of research architecture and design in the medical literature
- critically assess the scientific literature as presented in professional journals and the popular media
- Construct research questions with clear and specific aims

Course requirements / Grading

Course requirements are designed to focus on the development of skills and a knowledge base that should be useful as your research project develops – and beyond.

1. Class Participation (40%)

All students are expected to attend and participate in class discussion. The discussion groups provide a great opportunity to develop intellectual relationships with your peers, the Seminar Leaders, and to move your projects forward with help from the group in real time.

2. Daily Exercises (in class) (30%)

This course is a brief introduction to some of the fundamental principles of patient-oriented research. To deepen discussion and understanding of course topics, you will be asked to apply the concepts from the readings and didactics to your own research projects.

This process is not to be a burden or to interfere with the reading itself. The goal is to promote critical thinking, and to help students abstract a few key points from a group of readings. The ideas generated will guide our class discussion. These will be graded on quality, not the amount written.

3. Project proposal or abstract (not to exceed 5 pages) (30%)

A completed project proposal will be the final assignment. It should include specific aims, hypotheses if appropriate, background, methods, significance, limitations, and human subjects sections. As with all assignments, be sure to include appropriate

scientific citations. Details for this assignment will be discussed during class. Proposals due one week after the last class.

- Session 1** **Research Design**
Readings: Hulley, Chs. 1, 7
Supplementary Reading: Hulley, Ch. 8
- Session 2** **How to Ask a Research Question**
Readings: Hulley, Ch. 2
- Session 3** **Bias / Confounding**
Readings: Hulley, Ch. 9
- Session 4** **Data Collection**
Readings: Hulley, Ch. 15
- Session 5** **Qualitative Studies**
Readings: Bradley, JAMA articles (2)
Supplementary reading: Green, Kitto
- Session 6** **How to Write a Research Proposal**
Readings: Hulley, Ch. 19
- Session 7** **How to Write a Paper/ Give a Presentation**
Readings: Driscoll
Readings: Harradine
- Session 8** **Managing Mentors/ Special Topics / Wrap up**
Readings: Sackett, Thoma

Supplementary reading: Reynolds, DeLong

4. DEVELOPING A LABORATORY BASED RESEARCH PROJECT

There are many outstanding laboratory based research opportunities at YMS and outstanding faculty to serve as research thesis advisors. Students should begin by reviewing the Directory of Faculty Research Interests, available in hard-bound copy and on line. They should become familiar with the key words and multiple indices of the Directory. They should select 3-4 faculty, then make appointments with them, hear about their current research, and discuss possible research projects. Next, before making a decision, students should attend their lab meetings and meet separately with lab members over coffee. Medical students should use the NIH RePORTER at <http://projectreporter.nih.gov/reporter.cfm> which lists all NIH grants received by faculty members to determine the lab's funding. Reading the evaluations of former students who have worked in that lab and speaking with current or former students are very helpful in making a decision. Finally, they should then meet again with the chosen faculty member to develop a proposal for their research project.

5. DEVELOPING A CLINICAL RESEARCH, MIXED METHODS RESEARCH, OR EDUCATIONAL RESEARCH PROTOCOL: THE SURVIVAL GUIDE

Research in these areas encompasses a wide array of study types and methodologies. Detailing the many research study designs employed by clinical researchers is beyond the scope of this thesis guide. Whatever your research interest, you can likely find a qualified advisor in the medical school. But an advisor knowledgeable in your area may or may not have a strong background in research methods. If they do not, you should be prepared to follow a systematic process in the development of your project to be sure the results are what you intend.

Be advised that data do not make a thesis. Without a well-developed research question with clear and specific aims, collected data cannot lead to meaningful insights.

a. Quantitative Clinical and Education Research (research that involves comparisons):

The following sequence is recommended for the development of a clinical research, epidemiology, or educational research thesis project that involves comparisons. Don't wait for your advisor to bring up each component; they may never do so. You should be assertive in addressing the following items before you begin the actual research. If you and your advisor are uncertain about or want help with any of the steps below, there are experts in methodology available for consultation (See section on Secondary Thesis Advisors). Be sure to obtain such a consult early. There is little that methods can offer once the data have been collected.

1. Start with an excellent question. In general, "excellent" is best defined as a question for which the answer matters either to other researchers in the field, practicing clinicians, or patients. Remember, you will likely do just as much work to answer a question which has "below average" interest to others as you will in answering a question which others will call important.
2. Convert the question to a hypothesis by asserting a position. This will lead directly to a consideration of measures, both of exposure and outcome.
3. Generate measures of exposure and outcome. This step is facilitated by a review of the pertinent literature. How have other researchers defined/measured the exposure and/or

outcome? The effort to generate meaningful measures will generally require a return to the hypothesis for refinement, and narrowing (i.e., express the hypothesis in terms of the specific exposure of interest, and the specific outcome anticipated).

4. Next, a protocol should be constructed. How can the specific aims be accomplished? The first requirement is that a comparison be made. Here, too, a search of the literature for methods will be helpful. Choosing the right control group is challenging, and subtle. Once the comparison group is chosen, the magnitude of expected difference should be estimated, as a basis for determining sample size (power calculation). In educational research the intervention cannot be provided only to one group. In clinical research, standard methods include cohort studies (prospective, or retrospective; the randomized controlled clinical trial is a sub-category of the prospective cohort study) that assemble groups on the basis of exposure/intervention, and follow for outcome; and case-control studies that assemble groups on the basis of the outcome and assess for previous exposures. We urge you to use one of the three.
5. In light of the design you deem most appropriate, revise your measures of exposure and outcome as required. For example, in a prospective study, you can choose how to measure factors of interest, whereas in a retrospective study you will need to rely on measures obtained in the past, or the subjects' recall.
6. Once your measures are established, determine the appropriate sample size and the methods of analysis. A plan for data collection and management should also be developed. Consultation with a statistician may be helpful at this stage. Now is the time to assess feasibility. Specifically, the following questions should be addressed: Can enough people be obtained for the study? Can the outcome events be observed and suitably analyzed?

The research should only begin after steps 1-6 are dealt with successfully. Again, there are no methods or statistics that can transform a vague question and data into a methodologically rigorous study after the fact. Sound research design must come first.

b. What is educational research?

Research in medical education is a disciplined effort to ask questions through the collection and analysis of primary data, for the purpose of description, explanation, generalization, and/or prediction. Educational research is fundamentally a question-solving activity that addresses a problem and collects data to test a hypothesis or explain phenomenon. Educational research commonly uses qualitative or quantitative methodologies (used together referred to as 'mixed methods'). Characteristics of educational research include:

- Educational research attempts to answer an important problem of significance to other scholars in the area, and should be planned to result in a publication in a high quality peer reviewed journal. Medical students considering educational research should address an excellent question defined as follows: An excellent question is one that 1) other medical scholars in this area will find very interesting, 2) uses the best possible methods, and 3) if successful will be published in a high-quality peer-reviewed journal.
- Educational research involves gathering new data from primary or first-hand sources or using existing data for a new purpose.

- Educational research is based upon observable experience or empirical evidence and demands accurate observation and description.
- Educational research is a deliberate activity which is directional but often refines the problem or questions as the research progresses.
- Educational research should meet the highest standards of scholarship in this discipline and requires the faculty mentor advising the student to have the prerequisite training, expertise, competency in methodology, and technical skill in collecting and analyzing the data and publishing the results.

Educational research is not the development or implementation of a new module or course for medical students. This is the creation of a product, such as a painting or a book and creation of a product per se, while highly valuable, has never been considered research scholarship acceptable for the Yale MD thesis. To compare two ways of teaching a subject by defined outcomes, however, is considered research, if important variables, such as comparisons, statistics, and power calculations are used.

We encourage you to contact the Yale Teaching and Learning Center (janet.hafler@yale.edu). Faculty within this center are available to help identify the kinds of guidance best suited to your aims.

- c. **Non-quantitative Research (research that does not involve comparisons):**
There are clinical research designs that do not involve comparisons such as case studies series and qualitative research. Adherence to rigorous standards and accepted techniques in the pursuit of these types of studies ensures a high quality product.

6. QUALITATIVE RESEARCH STANDARDS AND TECHNIQUES

a. Developing a Qualitative or Mixed Methods Research Proposal

Qualitative Research is an inter-and trans-disciplinary field whose researchers are committed to a naturalistic perspective and to an interpretive understanding of human experience. How social experience is created and given meaning is at the heart of qualitative research. *Quantitative Research*, simply stated, emphasizes the measurement and analysis of causal relationships between variables (Denzin & Lincoln, p. 4)

Qualitative methods can provide insight regarding complex phenomena, contextualize quantitative data, or inform the design of research surveys. Qualitative and quantitative methodologies are commonly used together (referred to as ‘mixed methods’) in order to enrich the understanding of multifaceted data. Each can be used to test the findings of and add valuable insights to the other.

Before embarking on your project, it is very important to be certain that qualitative or mixed methods is the right approach for your study. Note the substantial time investment required on the part of the principal investigator to design, execute, analyze, and disseminate a well-done qualitative or mixed methods study. Be sure you can justify using these methods in your study proposal and meet with a faculty member experienced with qualitative research to help determine if this approach is appropriate for your research question. The following sequence is recommended for the development of a qualitative or mixed method thesis project. You should address these steps before undertaking any actual research. You must submit your

qualitative and mixed methods research proposals to the Human Investigations Committee for review.

1. Begin with an excellent research question with clear objectives. As in all types of research, an excellent question is one that 1) other medical scholars in this area will find very interesting, 2) uses the best possible methods, and 3) if successful will be published in a high-quality peer-reviewed journal. A research objective that can benefit from qualitative methods will typically be concerned with understanding social or psychological phenomena from the perspective of the study participants, understanding the socio-cultural or institutional context in which the phenomena occur, and understanding how the phenomena change over time or within different contexts. It is important to note that qualitative research does not seek to generate generalizations across populations, instead it generates analytic theories and categories. Therefore, qualitative research is inductive rather than deductive and your research objective may or may not seek to test a hypothesis.
2. The process of developing a novel research question should include your systematic review of the literature in order to determine the unique contributions of your proposed project. The literature review must be exhaustive and must demonstrate that either the literature is silent on the topic of interest or that prior quantitative and/or qualitative work has not adequately addressed the knowledge gap you have identified.
3. Identify the appropriate research framework to address your question. The research framework may include (here is a suggestion) the five research methods that will be discussed here are action research, case study research, ethnography, grounded theory, and Phenomenology, all of them considered examples of qualitative research.

Action Research

There are many definitions of action research, however the one most widely cited is that of Rapoport, who defines action research in the following way: Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework (Rapoport, 1970, p. 499). His definition draws attention to the collaborative aspect of action research and to possible ethical dilemmas that arise from its use. It is iterative in nature.

Case Study Research

Case study research is the most common qualitative method used in medical education. Although there are numerous definitions, Yin (1994) defines the scope of a case study as follows: “A case study is an empirical inquiry that: investigates a contemporary phenomenon within its real —life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin 1994, p. 13). One may use this method, for example, to study a question about an institution.

Ethnographic Research

Ethnographic research comes from the discipline of social and cultural anthropology where an ethnographer is required to spend a significant amount of time in the field. Ethnographers immerse themselves in the lives of the people they study (Lewis 1985, p. 380) and seek to place the phenomena studied in their social and cultural context. The classic book in medical education is *Boys in White* (Becker, HS, 1976). An outstanding award-winning thesis at YMS

described the personal life and pathos of a patient with “elephant man” disease or neurofibromatosis.

Grounded Theory

Grounded theory is a research method that seeks to develop theory that is grounded in data systematically gathered and analyzed. According to Martin and Turner (1986), grounded theory is “an inductive theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data.” The major difference between grounded theory and other methods is its specific approach to theory development, i.e., grounded theory suggests that there should be a continuous interplay between data collection and analysis.

Phenomenology

Phenomenology explores a specific social concept (e.g., shame, community) from the perspective of a few individuals in order to generate theories about the concept within specified contexts. In-depth data are gathered in narrative form from participants in order to explicate how they interpret and create meaning from these experiences.

4. Next you will identify your sample. If you are using mixed methods, you may be starting with quantitative data and analyzing it in order to narrow down your sample for in-depth qualitative study or you may start with a qualitative research design in order to design a quantitative data collection tool. In any case, sampling in qualitative research is important and can range from a case study to a random sample within a population. It is frequently purposive or theoretical. At times participants are selected for their experiences with the social and psychological phenomena under investigation and their ability to yield rich information. Sampling size will be determined by the research aims and strategy and can range from a few participants to many and from singular to multiple contexts. Many times data collection and analysis go hand-in-hand in qualitative research, thus the sampling strategy may not be completely determined at the onset of the project while other times the sampling is determined at the outset of the data collection. In some designs the sample size might evolve with the course of the research and will be determined when theoretical saturation is reached, that is until increasing sample size no longer yields new information, while in other designs this is not built into the design.

5. Once your objective is formulated, the research aims clarified, the strategy selected, and sample identified, a plan for data collection must be developed. This may include in-depth interviews, focus groups, participant observation, textual analysis (e.g., asking participants to keep food, exercise, or medical diaries) or a combination of these approaches. In-depth interviews are a commonly used strategy in qualitative and mixed methods approaches in clinical and health services research as well as observational and document analysis strategies. How do you determine whether an interview (focus group v. individual), an observation, document analysis or a survey is most appropriate? The decision depends on the research question. Data are typically recorded, transcribed, and verified prior to beginning analysis. Here are 3 examples:

In-depth Interviews: Participants’ experiences are explored in detail in typically one-on-one guided conversations. Interview guides may be used to direct the overall structure of the interview but participants are allowed to direct the course of the discussion in order to obtain information-rich data.

Focus Groups: are group interviews around a single topic of interest. They rely on interactions among group members to generate broader insights into shared experiences. How opinions are expressed or modified through group discussion is usually as important to the study as the topic itself.

Participant observation: is used in ethnographic research where the researcher observes or participates to a limited degree with the research subjects within their socio-cultural or institutional contexts.

6. Lastly, you will determine the appropriate method for analysis. You may need to assemble a diverse team of collaborators to help with data coding. You will need to identify at least one team member with qualitative expertise and one with content expertise. The team and coding plan needs to be determined *a priori*. This includes agreeing to a coding schedule and meeting times, choosing which, if any, qualitative software packages you will use to aid with data organization and management, consulting with available campus resources.

All of the above steps need to be addressed before undertaking your project. Working carefully through these considerations will enable you to identify whether or not a qualitative or mixed methods approach is appropriate and/or feasible. Will you have access to the data or participants you need? Is there sufficient time to collect and analyze data? Remember, qualitative research does not seek to determine prevalence, frequency, or magnitude. You will need time with your study participants and flexibility in order to obtain the in-depth and complex data you seek as well as time to conduct a rigorous analysis to yield meaningful scientific contribution.

The following resources may be helpful to you as you design a qualitative resource project:

- 1) Curry LA, Nembhard IM, Bradley EH. *Qualitative and Mixed Methods Provide Unique Contributions to Outcomes Research*. *Circulation* 2009;119:1442-1452
- 2) <http://www.qualres.org/>
- 3) http://obssr.od.nih.gov/scientific_areas/methodology/mixed_methods_research/index.aspx

The Yale postdoctoral fellows and faculty members listed below all have expertise in qualitative and mixed methods. These qualitative methodologists have agreed to work with a maximum of two students per year as a Consultant on initial research study design or as a secondary thesis Advisor. The methodologist should become involved on the student thesis at an early date (preferably in the first few weeks of the project and prior to any data collection). As a Consultant, the methodologist agrees to meet with students for one session prior to beginning the thesis project and one additional session after the data have been gathered. As an Advisor, the methodologist agrees to meet with students for up to four sessions prior to beginning the thesis project and for up to four additional sessions after the

data have been gathered. The initial meeting should be attended by the medical student, the primary thesis advisor, and the qualitative methodologist. The focus of this meeting will be on methodology.

Ejennifer.edelman@yale.edu
Marcella.Nunez-Smith@yale.edu
Nancy.kim@yale.edu
Janet.Hafler@yale.edu
David.Berg@yale.edu
Sakena.Abdedin@yale.edu
Marjorie.Rosenthal@yale.edu

Internal Medicine
 Internal Medicine
 Internal Medicine
 Associate Dean, Pediatrics
 Psychiatry
 Pediatrics
 Pediatrics

The following resources may be of help to you in developing or completing your thesis research:

b. Secondary Thesis Advisors

The Yale faculty members listed below all have expertise in the methodology of clinical studies, clinical epidemiology and biostatistics. These faculty members have agreed to work with a maximum of two students per year as a secondary thesis advisor. A secondary faculty advisor should become involved on the student's thesis at an early date (preferably in the first few weeks of the project and before any data are collected). The advisors have agreed to meet with students for four sessions at the beginning of the thesis project and an additional four sessions after the data have been gathered. The initial meeting should be attended by both the medical student, the primary thesis advisor and the secondary faculty advisor. The focus will be on developing excellent methodology. Please see the Directory of Faculty Research Interests for more detailed information on the faculty advisors specific areas of interest.

<u>NAME</u>	<u>DEPARTMENT (telephone)</u>
John Concato	Internal Medicine (203-932-5711, ext. 2993)
Karen Dorsey	Pediatrics (203-737-2182)
Tom Gill	Geriatrics (203-688-9423)
David Katz	Epidemiology & Public Health (203-732-7194)
Walter Kernan	Internal Med (203-764-7564)
Nancy Kim	Internal Med (203-764-5675)
Harlan Krumholz	Internal Med (203-764-5885)
John Leventhal	Pediatrics (203-688-2468)
Marcella Nunez-Smith	Internal Medicine (203-785-6454)
Patrick G. O'Connor	Internal Med (203-688-6532)
Eugene Shapiro	Pediatrics (203-688-4555)
Richard Schottenfeld	Psychiatry (203-974-7349; 203-432-0550)
Mary Tinetti	Geriatrics (203-688-5238)

Computer resources and facilities for statistical analysis that may be of help to you.

Yale's Prevention Research Center (PRC), located off-campus in Derby, is a resource to students needing assistance with data management and/or statistical analysis, survey development and validation, as well as refinement of clinical study methodology. The PRC data management staff will work with students to perform statistical analysis using a variety of software packages. Referrals can be provided as needed to additional resources available through the computer labs at the Yale Schools of Public Health, and Management. Contact the PRC at 203-732-1265, or Dr. Valentine Njike, data manager, at valentine.njike@yalegriffinprc.org.

7. **MEDICAL RESEARCH IN THE HUMANITIES AND THE ARTS: A SURVIVAL GUIDE**

Some students elect to conduct medical research for their M.D. thesis in one or another area of the humanities, social sciences, education, and the arts (including medical history, medical ethics, medicine and the law, film, photography, medical sociology, medical anthropology, and literature). Like other kinds of student research, the creative discipline required in pursuing the M.D. thesis in these areas helps shape the physician-scholar by cultivating critical judgment, imagination, and scholarship, while developing critical research skills and making an original contribution. At the same time, the challenges involved in research pursued in the archive, library, or field may differ from those encountered in the laboratory.

The Office of Student Research recognizes that distinct methodologies may be required for research conducted at the cutting edge of the humanities, social sciences, education, and the arts. It is committed to fostering an environment in which students are supported and encouraged to produce work of the highest quality and rigor that is in keeping with the best standards of scholarly research within the discipline in which they are working. Students who wish to pursue medical research projects in the humanities, social sciences, education, and the arts are eligible to apply for competitive research stipend support. Support from the Office of Student Research is given for student research stipends only, not for the costs of the research itself which is the responsibility of the faculty advisor.

Given the diverse nature of the fields encompassed by the medical humanities, education, and the arts, it is not possible to delineate a single method or approach that suits all projects. Students should work closely with their advisors to gain an understanding of the research methods and forms of analysis best suited to the discipline in which they are pursuing their thesis, or to develop approaches appropriate to interdisciplinary work. All research must attempt to answer a focused question related to medicine that is of interest to other scholars in the field. Research originates with a question, or hypothesis or problem, and requires a clear articulation of a goal and a systematic plan of approach. **A starting point is to review critically the research literature on the given question and related areas.**

It is important to recognize two ways in which rigorous research in the humanities, education, and the arts may differ from exploration in the laboratory and clinical sciences. First, such investigations may be (though by no means always) qualitative, and may not be advanced by statistical analysis. In other cases, studies would be significantly improved by a combination of qualitative and quantitative research methods. Second, while research in these fields must

answer an important question related to medicine, the question may not be formulated as a testable hypothesis. Alternative ways of thinking about the aims of a strong research project, informed by the best-practice research norms of different disciplines, are the construction of an evidence-based “argument,” or the production of generalizable knowledge, or (for the arts) the inclusion in the written thesis of material that is thoughtful, important, and makes an innovative contribution.

Medical students whose interests have led them to a set of questions about health and culture, medicine and society, may not know which scholarly fields offer the most promising research and analytical tools. If you were interested in a project that would make an innovative contribution to understanding the relationships between poverty and health in New Haven, for example, you might find yourself asking questions about culture that various interpretive methods from the humanities, social sciences, and the arts can help address. Perhaps you want to understand what health and illness mean to HIV-positive mothers and how they make sense of the relationship between health and poverty in managing the lives of their children. Or perhaps you want to understand how information about serving as a paid clinical research subject circulates in the community, and how the role of the healthy research “volunteer” is perceived. Or possibly your interest is in childhood obesity and you decide to explore sports, body image, and cultural esteem among 13 year old girls in an intercity school, or you decide to enlist photography as one medium to explore the nutritional environment of childhood poverty. All of these projects use methods regularly used by scholars in the social sciences, humanities, and the arts. If your research interests involve such questions about health, culture, education, and society, then we encourage you to begin a careful review of the scholarly literature on the topic. This is a critical first step. We also encourage you to contact the Yale Medical Humanities and the Arts Council (email john.warner@yale.edu) or the Yale Teaching and Learning Center (janet.hafler@yale.edu). Faculty within these units are available to help identify the kinds of guidance best suited to your aims.

Medical students may work with any approved Yale University faculty member on their thesis so long as the work is supervised, sponsored and approved by a full-time School of Medicine faculty member in whose department the thesis will be reviewed, and the Office of Student Research. Dual mentorship often is particularly appropriate to medical research in the humanities and the arts, and enables students to draw upon the rich mentorship resources available elsewhere in the University. The Humanities and the Arts Council can help students identify prospective medical school mentors, and also can help identify co-mentors from across the University whose primary faculty appointments are outside the School of Medicine.

8. ONE YEAR MEDICAL STUDENT RESEARCH FELLOWSHIPS

The School encourages many students to consider a fifth year of medical school and devote it exclusively to research funded by a formal One Year Student Research Fellowship. This Student Research Fellowship Program is facilitated by charging no tuition for the extra year and by the provision of a limited number of stipends that can be paid to students. In 2014-2015, twenty three (23) students received full one year fellowships and an additional 35 fifth year students received funding for less than a full year. Stipend levels are approximately \$22,920/year. These stipends are available on a competitive basis and students are eligible to apply after the second year. See separate booklet with details and deadlines on these fellowships. Current available funding sources include: Doris Duke International Clinical Research Fellowship, Howard Hughes Medical Institute, NIH Medical Research Scholars

Program, NIH-TL1-CTSA Award, Sarnoff Foundation, National Institutes of Health, American Heart Association, and Yale sponsored funding.

All stipends are paid directly to the student and are considered taxable income.

9. JOINT DEGREE PROGRAMS

a. Joint M.D./Master of Health Science Degree Program

Yale University School of Medicine and the Office of Student Research have established a new joint degree, the MD-Master of Health Science (MD-MHS) which was approved by the Yale Corporation in January 2006. There are currently 29 Yale medical students in this program.

There are two pathways in the MD- Master of Health Science degree for medical students. These are a clinical research pathway and a laboratory/translational pathway. The clinical research pathway also includes medical research projects in the broad areas of medicine and the humanities (medical history, medical -legal, bioethics, etc). The MD-Master of Health Science degree requires a fifth year pull out supported by a fully funded one year medical student research fellowship at Yale (currently Doris Duke Charitable Foundation, Howard Hughes Medical Institute-Yale, Yale NIH TL1, NIH-NIDDK, Yale Endowment Fellowships).

The research project in the fifth year is the centerpiece of the MD-Master of Health Science degree program. In addition are the following requirements:

The project mentor and a two or more person thesis committee must be approved by the Office of Student Research and the Master of Health Science Advisory Committee.

Additional coursework is required:

Clinical research pathway – Courses: IMED 625 Principles of Clinical Research; IMED 645 Introduction to Biostatistics in Clinical Investigation; Sect Ed 102 Organization and Leadership; Sect Ed 501b Responsible Conduct of Research (during Masters year)

Laboratory/translational research pathway – Courses: Sect Ed 101 Intensive Pedagogical Experience in Techniques and Strategies for Laboratory Research or Selected Seminars in CBB 740a Clinical and Translational Informatics; Sect ED 102 Organization and Leadership; Sect Ed 501b Responsible Conduct of Research (during Masters year)

These courses can be taken prior to the Masters year or during except the Responsible Conduct of Research which must be taken during the Masters year.

Participation in monthly seminars, journal clubs, Leadership in Biomedicine lectures and dinners, and other announced activities throughout the Masters year.

b. Joint M.D./M.P.H. Degree Program

For students in the M.D./M.P.H. Program, one thesis satisfies both degree requirements provided it is approved and carried out under a Yale faculty member of the Department of Epidemiology and Public Health and is in an appropriate subject area. The same regulations concerning content, organization and dates for submission of the M.D. thesis and review by the appropriate departmental committee will apply.

c. Joint M.D./J.D. Degree Program

The Yale School of Medicine has a formal relationship with the Law School to allow students to seek degrees from both schools. A focused M.D. thesis, answering a significant question of relevance to medicine is required for the M.D. portion of the degree.

d. Joint M.D./M.B.A. Degree Program

The purpose of the joint-degree program in medicine and management is to develop clinician-managers capable of pursuing careers that balance delivery of patient care with sound management in a changing health-care environment. The joint-degree program normally requires five years of study and simultaneous award of the degrees of Doctor of Medicine and Master of Business Administration at the conclusion of the five-year period. A focused M.D. thesis, answering a significant question of relevance to medicine is required for the M.D. portion of the degree.

e. Joint M.D./M.Div. Degree Program

Students who have been admitted to the Yale School of Medicine and are enrolled for the M.D. degree may apply to the Divinity School or admission to a combined program leading to the degrees of Doctor of Medicine and Master of Divinity. The joint program is tailored to the individual interests of students seeking professional education and training in a theological understanding of the self, society, and work; in bioethics; in international health and missions; in hospice or similar patient-care facilities; or in academic work in teaching, counseling and chaplaincy. A focused M.D. thesis, answering a significant question of relevance to medicine is required for the M.D. portion of the degree.

10. RESPONSIBILITY OF FACULTY MENTORS

To insure understanding of the faculty mentor's role, the following suggestions have been made:

- The faculty mentor should make every effort to orient the student to a feasible question that can be addressed within the available time. This usually requires multiple meetings with the student culminating in protocol and an application for funding which contains the following elements.
 1. background of the problem being investigated
 2. hypothesis that will be examined (if appropriate)
 3. specific aims of the study
 4. methods that will be used including details of the specific design of the study
 5. selected references from the sponsor's work
 6. selected references from others

The faculty mentor must review, approve and sign the application for funding. The application is also reviewed and must be approved for feasibility, specific aims, and study design by the Department Thesis Chair.

- We recommend that the actual time devoted to data collection (clinical, laboratory or other) be accomplished in a twelve-to-sixteen week period, minimally. Additional time is needed for planning and literature review, for evaluation of data and final write-up. Currently 70% of Yale students elect to spend a fifth year of medical school devoted fully or partially to thesis research. (See separate "One Year Medical Student Research Fellowship Information" available hardcopy and on line.)
- The student should not be assigned as a research technician to accomplish someone's project in the lab, including fellows.
- The faculty mentor should invest sufficient time in the student, including weekly meetings to discuss results and where necessary, help to focus (or refocus) the direction of the project.
- The student should develop with the faculty mentor his or her own project (although others may participate) and should eventually be encouraged by the faculty mentor to be first author on abstracts and publications.
- The faculty mentor is responsible for all research expenses (i.e. space, resources, and facilities) and the supervision of the student's work.
- The faculty mentor is the first reviewer and gives the initial approval of the thesis as submitted for graduation. (For more information see "Thesis Approval Process")
- The faculty mentor should plan to attend Student Research Day activities held in May of each year.

11. FUNDING FOR STUDENT RESEARCH

The Office of Student Research provides three types of stipend support for student investigators. These are:

- a. Summer Research
- b. Short-term Research
- c. One-year Medical Student Research Fellowships

All programs require a competitive application signed by the student. Summer research stipends are awarded specifically to students between the first and second year. Short-term stipends are awarded for specific blocks (1-3 months) during the academic year when full-time research is performed and during subsequent summers. These stipends are supported by a variety of organizations (NIH, Howard Hughes Program, private donors, and University funds.)

Deadlines for one year medical student research fellowships are available in the Office of Student Research and on our website. Deadlines for short term and summer research are listed below and also available on our website.

a. Summer Research Deadlines

April 22, 2016- Department Thesis Chair
May 6, 2016 - Office of Student Research

b. Short-term Research Deadlines (2015-2016)

July 24, 2015 – Department Thesis Chair
August 7, 2015 –Office of Student Research (Research Sep; Oct; Nov.)

October 23, 2015 – Department Thesis Chair
November 6, 2015– Office of Student Research (Research Dec; Jan; Feb.)

January 22, 2016 – Department Thesis Chair
February 5, 2016 – Office of Student Research (Research Mar; Apr; May.)

April 22, 2016 – Department Thesis Chair
May 6, 2016 – Office of Student Research (Research Jun; Jul; Aug.)

THESIS APPROVAL PROCESS

There are three levels of review of M.D. theses as follows:

- First Level** - Student/Thesis Advisor
- Second Level** - Departmental Review
(Departmental Thesis Committee)
- Third Level** - Thesis Awards Committee
(Thesis Committee)

1. All students expecting to graduate in May of a given year, complete in the fall of the preceding year, a Thesis Information Form indicating:

- the title of his/her thesis;
- his/her advisor and department

This Thesis Information Form must be signed by the student and forwarded to the Director, Office of Student Research.

2. Students must include in the methods portion of their thesis, specific details of exactly which procedures, methods and experiments were conducted by the student and which procedures, methods and experiments, generation of data, or production of reagents, were performed by others. It is recognized that students may often be completing a portion of a larger work. A statement detailing precisely what was done by the student and what was done by others does not detract from the thesis and is necessary for academic honesty.

3. Following writing, reviewing and editing of drafts of the thesis by the student and approval by his/her thesis advisor, a formal letter from the faculty advisor must be sent to the Department Thesis Committee Chairperson indicating faculty approval of the thesis. The advisor must be a member of the full time faculty at the School of Medicine. This letter should accompany the submission of the thesis by the student for departmental review. This letter should state that the work is original and has been done by the student.

4. All student theses should be reviewed by at least one external reviewer at the Departmental Thesis Chair level of review. An external reviewer is defined as external to the specific project and may be a member of the department or the section where the work is performed or may be a member of another department. This reviewer is strongly urged to meet in person with the student to describe her/his comments and suggestions. A written summary of the reviewers critique (which may be brief) should be sent to the student and to the Department Thesis Chairperson.

5. Changes recommended by the reviewer(s) are then incorporated into the final bound thesis copy. Upon completing the recommended changes the student will be notified by the Departmental Thesis Chair of his/her approval and the student can proceed on binding the thesis and final submission to the Office of Student Research.

12. THESIS AWARDS

1. Recommendations for Honors - Elements of the third review (Awards Committee). The basis for honors should be an excellent to outstanding thesis with original observations already published in a peer-reviewed journal, or submitted for publication, or planned submission by a certain date, or judged worthy of publication in a peer-reviewed journal. This information should be included in the letter from the advisor, including details of the publication ie. already published, submitted, planned by a date or a thesis. One thesis per department, or 20% of the total theses done in a department may be submitted for honors only if each meets the criterion for honors.

2. Theses submitted by the Departmental Thesis Committee to the Thesis Awards Committee for honors consideration must be accompanied by the following:

a) a letter from the faculty advisor recommending the thesis for honors, indicating why it is recommended and stating specifically all methods and data generated by the student and all methods and data generated by others. The letter should indicate any publications resulting from the work or in preparation. To be considered for honors, the faculty advisor must indicate that in his or her opinion, the work of the student is definitely considered to be worthy of publication in a peer-reviewed journal and details of this publication should be given as above.

b) a letter from the Department Thesis Committee Chairperson indicating the reasons for recommending for honors. Comments or a letter from the external reviewer may also be included.

Note: If more than one thesis is submitted by a Department, the Departmental Thesis Committee should list in rank order the department's nomination for honors.

13. REQUIRED COMPONENTS OF THE FORMAL M.D. THESIS

a. **Hard bound copy**

Both a hard bound and a digital copy are required as below

(In Order for Final Submission of Bound Copy)

Length- Most Yale M.D. theses average 40-80 pages of text. A minimum of 30 pages of text excluding figures, legends, and references is required.

1. **Title page.** - Title should not exceed 100 characters including spaces between words (see details page 30).
2. **Abstract** page, as described, (see details page 40).
3. **Acknowledgements** (personal and faculty acknowledgements, grant support, departmental support, etc.).
4. **Table of Contents**, with page numbers for each section.
5. **Introduction** (a thorough, complete, detailed and relevant review of the literature is required).
6. **Statement of purpose, including specific hypothesis if appropriate, and specific aims of the thesis.**
7. **Methods – Please Note:** Give details of all methods used. Describe in detail exactly which procedures, methods and experiments were conducted by you and which procedures, methods and experiments, generation of data, or production of reagents, were performed by others. It is not sufficient to state that this information may be mentioned elsewhere. It must be summarized here.

It is recognized that students may often be completing a portion of a larger work. A statement detailing precisely what was done by the student and what was done by others does not detract from the thesis but is necessary for academic honesty.

If pictures are used you must obtain written permission from patients, parents or guardians and this should be added to the methods section. You could also consider masking faces or eyes.

8. **Results** – All primary data related to the thesis topic should be presented with the important data given in figures or tables. If preferred, figures and tables should be included in this section and should be explained in detail in the text. Tables and figures can be presented separately after the discussion but, if possible, it is advantageous to the reader to include tables in the body of the results section (as in a manuscript). All data should include the number of observations, and mean values \pm S.E.M. or \pm S.D.
9. **Discussion.** (Thorough and detailed interpretation and analysis of data and reference to and analysis of other literature.)
10. **References** – We strongly recommend the use of Endnote for formulating the references. Indicate references in the text by sequential numbers in parentheses (do not use subscript). In the Reference section, list references numbered in the order in which they appear in the text in the format shown below (note that the initials of the authors always follow the surnames, and that there should be no space between more than one initial). Include all authors' names up to 5 authors (use *et al.* after the 5th author) and complete article titles. Indicate articles that are in press following the journal name.

Abbreviate the names of journals according to *Pub Med* or *BIOSIS Database*. Spell out names of unlisted journals. Supply inclusive page numbers. Submitted manuscripts, manuscripts in preparation, unpublished observations, personal communications, and preliminary report citations must appear parenthetically in the text. They should not appear in the Reference section. See examples below:

Journal style guides and Endnote style files for the *Journal of Clinical Investigation* and *New England Journal of Medicine* – are also acceptable.

Journal Articles

1. Yalow, R.S., and Berson, S.A. 1960. Immunoassay of endogenous plasma insulin in man. *J. Clin. Invest.* 39:1157-1175.

In Press

2. Gardner, W., and Schultz, H.D. 1990. Prostaglandins regulate the synthesis and secretion of the atrial natriuretic peptide. *J. Clin. Invest.* In press.

Complete books

3. Myant, N.B. 1981. *The Biology of Cholesterol and Related Steroids*. London: Heinemann Medical Books. 882 pp.

Articles in books

4. Innerarity, T.L., Hui, D.Y., and Mahley, R.W. 1982. Hepatic apoprotein E (remnant) receptor. In *Lipoproteins and Coronary Atherosclerosis*. G. Nosedá, S. Fragiaco, R. Fumagalli, and R. Paoletti, editors. Amsterdam: Elsevier/North Holland. 173-181.

Abstracts

5. Packman, C.H., Rosenfeld, S.I., and Leddy, J.P. 1981. Inhibition of the C8/C9 steps of complement lysis by a high density lipoprotein (HDL) of human serum. *Fed. Proc.* 40:967a. (Abstr.)

11. **Figure References and Legends.** Figures must be cited sequentially in the text using Arabic numerals (for example, "Fig. 7"). Provide a short title (in the legend, not on the figure itself) and explanation in sufficient detail to make the figure intelligible without reference to the text (unless a similar explanation has been given in another figure). Provide a key to any symbols used.
12. **Tables.** All tables should be double-spaced on manuscript pages. Tables should be self-contained and self-explanatory. Provide brief titles and use superscript capital letters starting from A and continuing in alphabetical order for footnotes.

NOTE: **For Bound Copy:** The full thesis title, the student's full name, "Yale University", and the year of degree should be imprinted on the cover. An abbreviated title, student's name and year should be imprinted on the spine.

a. Thesis Typing and Assembly Instructions

The final submission of the M.D. thesis should meet the following requirements:

Paper: 20 lb. weight paper of good quality (standard copy paper). All pages must be a high-contrast, dark image on white paper.

Print Size: Use a 10-12 point font.

Typing: Double spaced on one side of the page. Single spacing may be used within block quotations, footnotes, and bibliography, but double spacing must be used between successive entries.

Margins: 1-1/2 inch left hand margin (normally, the binding edge), 1 inch on the three other edges. These margins apply to full-page photographs and pages containing tables and illustrations, as well as to pages of text.

Figures: Ordinarily, photographs should be scanned and entered electronically into the text. To mount photographs, use Duco or equivalent cement, rubber cement or "permanent" glue. Regular glue, picture corners, and adhesive cellophane are not acceptable. If charts, graphs, maps, tables, or computer printouts that are larger than the standard size are to be used, they should be folded carefully into the manuscript, with the fold at least 1/2 inch from the right hand edge of the page.

Figure Legends should be detailed and should be placed below the illustrative material.

A legend may appear, however, on a facing legend page when both illustration and the legend cannot be accommodated on one page.

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Yale University School of Medicine
in Partial Fulfillment of the Requirements for the
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by

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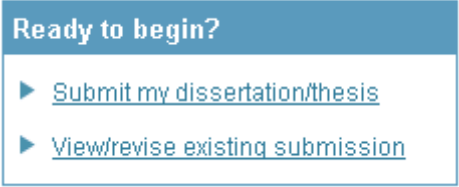
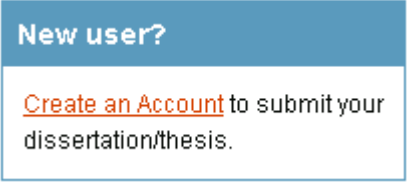
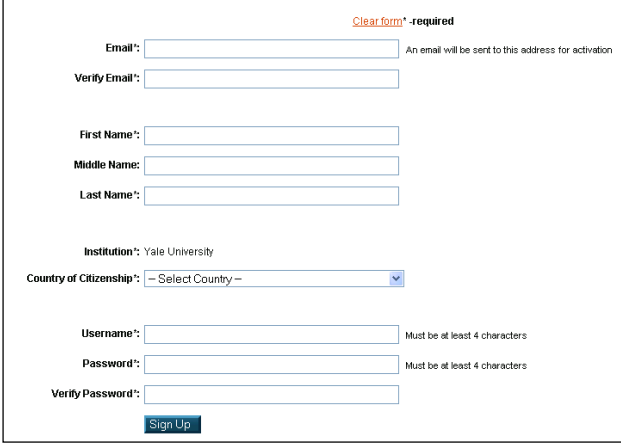
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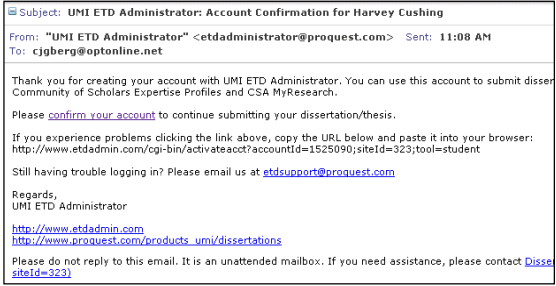
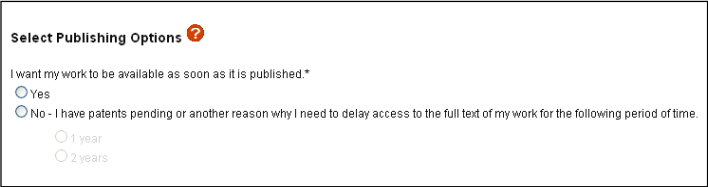
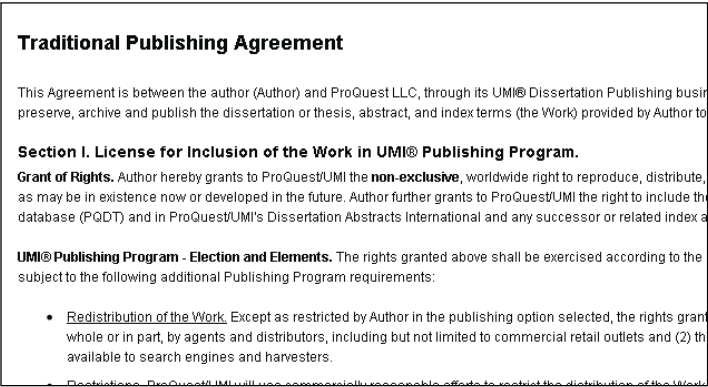
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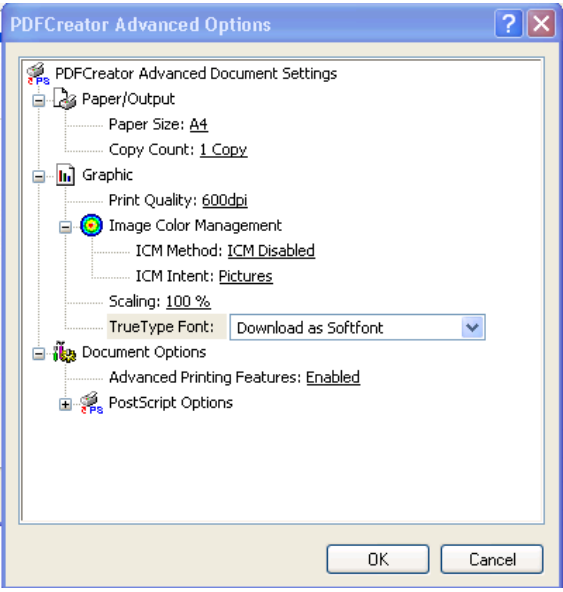
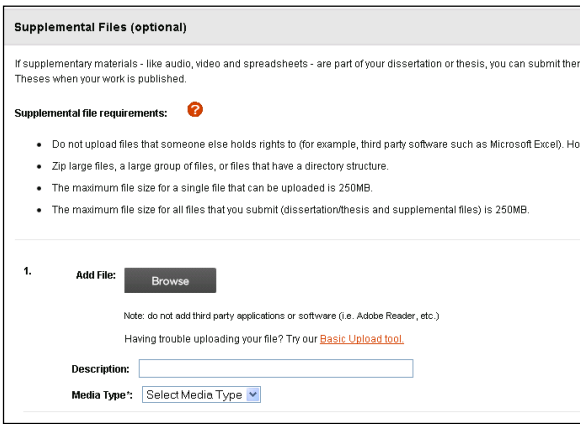
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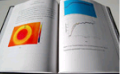
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<p>5.</p>	 <p>The screenshot shows an email with the following content:</p> <p>Subject: UMI ETD Administrator: Account Confirmation for Harvey Cushing</p> <p>From: "UMI ETD Administrator" <etdadministrator@proquest.com> Sent: 11:08 AM To: cjgberg@optonline.net</p> <p>Thank you for creating your account with UMI ETD Administrator. You can use this account to submit dissertations to the Community of Scholars Expertise Profiles and CSA MyResearch.</p> <p>Please confirm your account to continue submitting your dissertation/thesis.</p> <p>If you experience problems clicking the link above, copy the URL below and paste it into your browser: http://www.etdadmin.com/cgi-bin/activaterequest?accountid=1525090;siteid=323;tool=student</p> <p>Still having trouble logging in? Please email us at etdsupport@proquest.com</p> <p>Regards, UMI ETD Administrator</p> <p>http://www.etdadmin.com http://www.proquest.com/products_umi/dissertations</p> <p>Please do not reply to this email. It is an unattended mailbox. If you need assistance, please contact Dissertation Support (siteid=323)</p>	<p>You will receive an email confirmation that must be responded to before you can continue your thesis record and deposit. Click on Confirm your Account.</p>
<p>6.</p>	 <p>The screenshot shows a form titled "Select Publishing Options" with the following content:</p> <p>Select Publishing Options</p> <p>I want my work to be available as soon as it is published.*</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No - I have patents pending or another reason why I need to delay access to the full text of my work for the following period of time.</p> <p><input type="radio"/> 1 year</p> <p><input type="radio"/> 2 years</p>	<p>Select Publishing option for your relationship with UMI. Your signed Yale MD Thesis Depositor Declaration will be the effective control for the local Yale digital copy that will be maintained on a Yale Library server with either restricted or public access.</p>
<p>7.</p>	 <p>The screenshot shows a document titled "Traditional Publishing Agreement" with the following content:</p> <p>Traditional Publishing Agreement</p> <p>This Agreement is between the author (Author) and ProQuest LLC, through its UMI® Dissertation Publishing business, to preserve, archive and publish the dissertation or thesis, abstract, and index terms (the Work) provided by Author to ProQuest/UMI.</p> <p>Section I. License for Inclusion of the Work in UMI® Publishing Program.</p> <p>Grant of Rights. Author hereby grants to ProQuest/UMI the non-exclusive, worldwide right to reproduce, distribute, and make available in existence now or developed in the future. Author further grants to ProQuest/UMI the right to include the Work in ProQuest/UMI's Dissertation Abstracts International and any successor or related index and database (PQDT) and in ProQuest/UMI's Dissertation Abstracts International and any successor or related index and database (PQDT) and in ProQuest/UMI's Dissertation Abstracts International and any successor or related index and database (PQDT).</p> <p>UMI® Publishing Program - Election and Elements. The rights granted above shall be exercised according to the subject to the following additional Publishing Program requirements:</p> <ul style="list-style-type: none"> Redistribution of the Work. Except as restricted by Author in the publishing option selected, the rights granted to ProQuest/UMI shall include the right to reproduce, distribute, and make available in whole or in part, by agents and distributors, including but not limited to commercial retail outlets and (2) the right to make the Work available to search engines and harvesters. 	<p>Accept the Traditional Publishing Agreement offered by ProQuest/UMI. In addition, through the Yale Thesis Depositor Declaration you submit in the Office of Student Research, there will be a copy available to a researcher that does not require payment, which you can choose to restrict to campus access only or release publically.</p>
<p>8.</p>	<p>Please complete the contact information necessary to maintain contact with</p>	<p>Please complete the contact information necessary to maintain contact with</p>

	<div data-bbox="347 170 1057 625"> <p>Contact Information</p> <p>Please enter your contact information. This information will be used to process your submission.</p> <p>Required fields are marked with an asterisk (*).</p> <p>First Name*: <input type="text" value="Harvey"/></p> <p>Middle Name: <input type="text"/></p> <p>Last Name*: <input type="text" value="Cushing"/></p> <p>Country of Citizenship*: <input type="text" value="United States"/></p> <p>Institution*: <input type="text" value="Yale University"/></p> <p>Permanent email address*: <input type="text" value="cjbberg@optonline.net"/></p> <p>Country code (outside US) Area code Phone Extension</p> <p>Phone Number: <input type="text" value="1"/> <input type="text"/> <input type="text"/> <input type="text"/></p> <p>Fax Number: <input type="text" value="1"/> <input type="text"/> <input type="text"/> <input type="text"/></p> </div>	<p>UMI/Proquest and receive potential royalty payments.</p>
<p>9.</p>	<div data-bbox="347 837 1052 1209"> <p>Title*: <input type="text" value="Neurosurgical approaches to brain tumor removal"/></p> <p>Year Manuscript Completed*: <input type="text" value="2011"/></p> <p>Degree/Department Information:</p> <p>Year Degree Awarded*: <input type="text" value="2011"/></p> <p>Degree Awarded*: <input type="text" value="Doctor of Medicine (M.D.)"/></p> <p>Department*: <input type="text" value="Yale School of Medicine"/></p> <p>Advisor/Committee Chair*:</p> <p>Enter your primary advisor(s), not your entire committee. Do not include degrees as part of the name.</p> <p>First Name: Middle Initial: Last Name:</p> <p><input type="text" value="Dennis"/> <input type="text" value="D"/> <input type="text" value="Spencer"/></p> </div>	<p>On the next screen, fill in as much basic descriptive information about your thesis as possible, including the thesis abstract and subject keywords. The subject keywords will be reviewed and standardized to NLM MeSH subject headings prior to public release.</p>
<p>10.</p>	<div data-bbox="347 1346 1052 1711"> <p>PDF</p> <p>You must upload your work as a PDF. If you don't have a PDF file yet, you can convert your manuscript to PDF using the conversion tool we provide.</p> <p>Other PDF Requirements:</p> <ul style="list-style-type: none"> • Fonts must be embedded. • Security settings must be set to "No security". Encrypted files cannot be processed for publishing. • The maximum file size that can be uploaded is 250MB. <p>PDF: <input type="button" value="Browse"/></p> <p>Having trouble uploading your file? Try our Basic Upload tool.</p> <p><input type="button" value="Save & Continue"/></p> </div>	<p>On the following upload screen, note that “fonts must be embedded”.</p>

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<p>12.</p>		<p>The next screen will allow you to upload supplemental files. You will be advised not to upload copyrighted documents or applications, and the size limit for individual items is limited to 250 MB.</p>
<p>13.</p>		<p>The next screen will allow you to provide information</p>

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Degree: Doctor of Medicine (MD)

Title: Neurosurgical approaches to brain tumor removal

Abstract: John F. Fulton's biography of his mentor and friend, Harvey Cushing, was the first book-length biography of the great neurosurgeon and teacher and has remained the standard source on his life. When Cushing died in 1939, he left funds in his will for his wife and Fulton, his literary executor, to compile a biography if they "feel that the publication of my biography may be of interest or help to medical students." Copiously illustrated with photographs and Cushing's own drawings, Harvey Cushing: A Biography was published for the Historical Library in 1946 and dedicated to Cushing's wife, Kate Crowell Cushing.

Subject Categories: Health Sciences, Medicine and Surgery (0564) - primary
Health Sciences, Rehabilitation and Therapy (0382)

Keywords: brain
salad
surgery

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c. Abstracts of M.D. Theses

Some abstracts of Yale medical student theses are published in *The Yale Journal of Biology and Medicine*. A standardized format for the abstract of each M.D. thesis is required (see the following instructions on page 40). **This format must be followed for all abstracts published both in the bound thesis, in the digital copy (Yale Medical Thesis Digital Library) and in the abstract submitted for publication.**

The editors of *The Yale Journal of Biology and Medicine* will not review abstracts for content. It is the responsibility of the student investigator and the faculty advisor to prepare the abstract. Faculty sponsors give approval of the abstract when they approve the final version in the bound thesis. The editors of the Digital Thesis Library will ensure that all requested thesis abstracts are available to the *Yale Journal of Biology and Medicine* without additional steps required of students.

Digital publication of theses insures access for all scientists to a summary of such work, provides students with a formal citation for their thesis, and demonstrates the exceptional quality of student research and student-faculty cooperation at Yale.

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1. Abstracts may be typed or printed by word processor on standard 8 1/2" x 11" white paper with 1-1/2 inch left hand margin (normally, the binding edge), 1 inch on the three other edges. Abstracts may be no more than 500 words in length, not including title and author information. Entire abstract including title page must be double-spaced and should be no more than one page at length.
2. Titles should be brief, clear and carefully chosen. The title should not exceed 100 characters including spaces between words. Capitalize entire title, using no abbreviations.
3. Authors' names are to be written in full, omitting degrees. The student author's name shall be first. If the faculty sponsor also qualifies as an author, his or her name should be last. If the faculty member has been only a sponsor, his or her name should appear in parentheses after the name(s) of other authors as follows: "(Sponsored by...)". Other collaborators should be listed after the student's name and before the faculty sponsor's name. Immediately following the faculty sponsor's name, designate section (if any), departmental affiliation, institution, city and state (Yale University School of Medicine, New Haven, CT (see examples).
4. For thesis work done at another institution, designate senior author's departmental and institutional affiliation. In parenthesis, indicate Yale faculty sponsor and institutional affiliation with the phrase: "Sponsored by..." (see examples).
5. Organize the body of abstract as follows:
 - A statement of the hypothesis or goals and specific aims of the study.
 - A statement of the methods used.
 - A summary of the results presented in sufficient detail to support the conclusions. Include actual values with statistics, if appropriate.
 - A statement of the conclusions reached.
 - Do not use subtitles; e.g., methods, results.
6. Do not include graphs, references to other publications, or acknowledgement of any research grant support. A single short table of results can be used if appropriate.
7. Abbreviations may be used in text only if defined initially by placing them in parenthesis after the full work first appears in the text. Abbreviations may not be introduced in the title.
8. Non-proprietary (generic) names are required the first time a drug is mentioned, written in small letters. Proprietary names are always capitalized, e.g., acetazolamide (Diamox).
9. Completed abstracts must be approved by faculty advisor.

Examples of Titles and Authors of Abstracts:

- 1) Thesis done at Yale:

INCIDENCE OF SUPRAVENTRICULAR ARRHYTHMIAS IN AN AGING POPULATION.
John M. Smith, Walter T. Donigan, and Marion L. Green. Section of Cardiology, Department of Internal Medicine, Yale University, School of Medicine, New Haven, CT.

- 2) Thesis done at Yale, where faculty advisor is not a co-author:

INCIDENCE OF SUPRAVENTRICULAR ARRHYTHMIAS IN AN AGING POPULATION.
John M. Smith and Walter T. Donigan (Sponsored by Marion L. Green). Section of Cardiology, Department of Internal Medicine, Yale University, School of Medicine, New Haven, CT.

- 3) Thesis done elsewhere:

INCIDENCE OF SUPRAVENTRICULAR ARRHYTHMIAS IN AN AGING POPULATION.
John M. Smith and Walter T. Donigan. Section of Cardiology, Department of Internal Medicine, St. Elsewhere Hospital, Boston University, Boston, MA. (Sponsored by Marion L. Green, Department of Medicine, Yale University School of Medicine).

14. THESIS COMMITTEES
a. Departmental Thesis Committee

Each Department Chairperson will appoint a Departmental Thesis Committee of three senior faculty members who will be responsible for approving completed dissertations done within that department. 2015-2016 Departmental Thesis Committee Members are:

Anesthesiology	Dr. David Silverman	Neurosurgery	Dr. Angeliki Louvi
Biomedical Engineering	Dr. Tarek Fahmy	Obstetrics & Gynecology & Reproductive Sciences	Dr. Joshua Johnson
Cell Biology	Dr. Peter Takizawa	Ophthalmology & Visual Science	Dr. Z. Jimmy Zhou
Child Study Center	Dr. Andres Martin	Orthopaedics & Rehabilitation	Dr. Jonathan Grauer
Dermatology	Dr. Oscar Colegio	Pathology	Dr. Jose Costa
Emergency Medicine	Dr. Brian Biroscak	Pediatrics	Dr. Jeffrey Gruen
Genetics	Dr. Margretta Seashore	Pharmacology	Dr. Titus Boggon
History of Medicine	Dr. Joanna Radin	Physiology (Cellular & Molecular)	Dr. Biff Forbush
Immunobiology	Dr. Kevan Herold	Psychiatry	Dr. Marc Potenza
Internal Medicine	Drs. Lloyd Cantley and Erica Herzog	Radiology and Biomedical Imaging	Dr. Cicero Silva
Laboratory Medicine	Dr. Peter Tattersall	School of Public Health	Dr. Elizabeth Claus
Molecular Biophysics & Biochemistry	Dr. William Konigsberg	Surgery	Dr. John Geibel
Neurology	Drs. Emily Gilmore and Kevin O'Connor	Therapeutic Radiology	Dr. Roy Decker
Neuroscience	Dr. Michael Schwartz	Urology	Dr. Toby Chai

b. The Thesis Committee (serves as the Thesis Awards Committee)

A Thesis Committee has been formed and meets regularly to recommend policy to the Curriculum Committee for all aspects of the Thesis requirement. Specifically, rules and regulations are set and deadlines established. The Committee also serves as the Thesis Awards Committee, acting as a reviewing body to determine oral presentations at Student Research Day, graduation thesis prizes and guidelines for the awarding of prizes. The 2015-2016 Thesis Committee Members are:

Dr. Nancy R. Angoff	Dr. Barbara Kazmierczak
Dr. Jeffrey Bender	Dr. Nancy Kim
Dr. Emile Boulpaep	Dr. Marie Landry
Dr. Jose Costa	Dr. Forrester A. Lee
Dr. Anne Curtis	Dr. Richard Lifton
Dr. Michael DiGiovanna	Dr. I. George Miller
Dr. Thomas Duffy	Dr. Joanna Radin
Dr. John N. Forrest, Jr.	Dr. Peter Takizawa
Dr. Amy Justice	Dr. Bruce Wexler

15. OFFICE OF STUDENT RESEARCH

The Chairperson of the Thesis Committee has established an office dedicated to student research where lists of faculty research interests are kept up to date; deadlines and applications for stipends are available; where advice can be given to students searching for research projects; where information about past student projects is kept; and where sources of funds can be reviewed. The Office of Student Research is under the direction of Dr. John N. Forrest, Jr. Specific questions about the thesis requirement should be directed to Donna Carranzo, Mae Geter, Kelly Jo Carlson or Dr. Forrest at the Office of Student Research, 3rd Floor Harkness Dorm, 310 ESH, 203-785-6633.