**Description**

The goal of the comprehensive exam is to determine whether the student's depth and breadth of knowledge and ability to integrate information is within a scope expected as part of a master's program in clinical and translational science (CTS). The comprehensive exam is a required component of the MS program and evaluates skills learned in the CTS core courses. This is a rigorous exam and is designed to evaluate 1) how well students understand the concepts taught in the CTS core courses, and 2) how well students can apply these concepts to new research situations. Anything taught as part of the core courses may be evaluated as part of the exam.

**Core Courses**

Investigation and Surgery tracks: CTS 301, 305, 310, 315, 320, 325
Research Management track: CTS 301, 305, 308, 309, 310, 315, 320

**Comprehensive Exam Committee**

A Comprehensive Exam Committee will be assembled by the CTS Academic Advisor and student. Students have a right to request certain faculty not be appointed to their Committee, per UVM Graduate College policy. The Committee will consist of 3 members:

- 2 Key CTS Faculty Members. Please see the definition of Key CTS Faculty for current Members.
- 1 Graduate College Faculty with content expertise. This person may or may not be Key CTS Faculty.

Note: The CTS Academic Advisor, Research Mentor, Internship Mentor and any member of the Thesis Committee may not serve on the Comprehensive Exam Committee to avoid any real or perceived conflicts of interest. One Comprehensive Exam Committee member shall be appointed as chair by the committee and hold the responsibility of overseeing the exam and reporting to the student's Academic Advisor with the student's exam performance.

**Comprehensive Exam Process**

1. The comprehensive exam should be completed within 6 months of finishing the CTS core courses. The student should work with their CTS Academic Advisor to assemble a Comprehensive Exam Committee and target date for the oral exam. Student must submit CTS Comprehensive Exam Committee Membership Form to CTS Program Specialist. For thesis tracks: The comprehensive exam should be completed at least 6 months prior to the thesis defense per UVM Graduate College policy.

2. Once the student has identified a proposed research question for the exam (see Written Exam below), the student should present the research question to the Comprehensive Exam Committee for approval in an email. The student should have a minimum amount of contact with the Committee to ensure that the exam is completed independently.

3. Once the research question is approved by the Comprehensive Exam Committee, the student should confirm the exam date with their committee, CTS Academic Advisor and CTS Program Specialist. Students should reserve a room on UVM campus for the oral exam for a 1 hour period.
4. The Comprehensive Exam Committee must approve the exam research question before the student prepares his or her project summary.

5. Students should submit their written exam to the Comprehensive Exam Committee at least 1 week in advance of the oral exam. See “Written Exam” below for specific instructions in preparing the written exam.

6. Students should send an email reminder to the Committee the day before the oral exam.

Note: The student may work with the CTS Program Specialist for assistance with room scheduling and exam process.

**WRITTEN EXAM**

The written exam has two parts. The first part is writing a 1-2 page NIH-style project summary of a grant protocol. The second part requires an analysis of an existing dataset using the concepts learned in the core courses.

**Prepare the written exam in the format that follows:**

<table>
<thead>
<tr>
<th>Title Page</th>
<th>Limited to 1 page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No NIH format for the title page. Include the following:</td>
</tr>
<tr>
<td></td>
<td>• Name</td>
</tr>
<tr>
<td></td>
<td>• Names of Comprehensive Exam Committee Members</td>
</tr>
<tr>
<td></td>
<td>• Date Submitted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Summary*</th>
<th>Limited to 1-2 pages; Include a Protocol Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Project Summary is meant to serve as a succinct and accurate description of the proposed work. State the application’s broad, long-term objectives and specific aims. Describe concisely the research design and methods for achieving the stated goals. This section should be informative to other persons working in the same or related fields and insofar as possible understandable to a scientifically or technically literate reader. Avoid describing past accomplishments and the use of the first person.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Case Study Statistical Analysis</th>
<th>Include the following:</th>
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<tbody>
<tr>
<td></td>
<td>• Table 1</td>
</tr>
<tr>
<td></td>
<td>• One or more tables summarizing the descriptive statistics and hypothesis tests</td>
</tr>
<tr>
<td></td>
<td>• One copy of the analysis from the statistical software package of your choice</td>
</tr>
</tbody>
</table>

*Project Summary

Students must select a novel research question that meets the FINER criteria (feasible, interesting, novel, ethical, and relevant). Although the CTS Academic Advisor, Research Mentor, or Internship Mentor may not serve on the Comprehensive Exam Committee or assist the student in completing the exam, students may review their ideas for research questions with these individuals to identify a question. For thesis tracks: *The research question must be*
**different enough from the student’s thesis work that if both research questions were submitted for funding to NIH they would be considered separate applications.** Students should be aware that there is no obligation to pursue any of the proposed studies. The project summary is specifically for exam purposes only.

To the students:
When you have selected a research question, ask yourself these questions before requesting approval from your Committee:

1. **Is this research question FINER?**
2. Can you state concisely the goals of the proposed research and summarize the expected outcome(s), including the impact that the results of the proposed research will exert on the research field(s) involved? (From NIH Specific Aims)
3. Can you list succinctly the specific objectives of the research proposed, e.g. to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology? (From NIH Specific Aims)
4. **Is this research question within the scope of an NIH R03?**
   a. NIH Small Research Grant Program (R03) Description: Small Research Grants support small research projects that can be carried out in a short period of time with limited resources for projects such as pilot or feasibility studies; secondary analysis of existing data; small, self-contained research projects; development of research methodology and/or development of new research technology.

**Case Study Statistical Analysis**

1. Review the case and analysis questions below.
2. Contact Rich Pinckney or Peter Callas for access to the dataset.

**Case**
We are wondering whether having a pet in the home is associated with a lower pulse rate. There are several theories that owning a pet may lead to lower pulse rates, possibly through increased walking or by experiencing relaxation through companionship.

1. Please test the hypothesis that having a pet in the house is associated with a lower pulse rate.
2. As part of this analysis we would also like to look at other variables about having a pet that might be important to know. Please make a Table 1, with weight, sex, age, and marital status compared between those with and without pets.
3. Include descriptive statistics, effect sizes, and P values. Be prepared to describe your rationale for test choice, definition of variables, and to interpret the results.
4. Investigation and Surgery Tracks only: Use linear regression to see if adjusting for any of the variables in your Table 1 changes the relationship between pet ownership and pulse rate.

**ORAL EXAM**
Students will meet with their Comprehensive Exam Committee to answer questions related to the written exam and concepts taught as part of the CTS core courses. No formal presentation of the written protocol is required as part of the oral exam. Students should dress appropriately for a formal exam and be prepared for 1 hour of examination. After the Committee is satisfied that all questions have been answered, the student will be excused from the room while the Committee discusses the student’s performance (See Grading below)
The exam will last approximately 1 hour with the following agenda:

- Introduction and announcement of exam procedures (5 minutes)
- Student questions and answers (30-40 minutes)
- Faculty assessment (student will leave the room during this discussion) (10 minutes)
- Review of Assessment with student (10 minutes)

To the student:
The Comprehensive Exam Committee will use your written exam project summary and statistical analysis as the framework for asking questions. However anything taught in your core courses may be asked in the oral exam. Example questions include but are not limited to the following:

**CTS 301: Designing Clinical and Translational Research**
- Describe the strengths and weaknesses of the design you selected for your research question. What other designs could you have used? What tradeoffs did you make in selecting one design over another?

**CTS 305: Cell to Society**
- You have been asked to choose the next Cell to Society topic. What will you choose and why?

**CTS 310: Conducting Clinical & Translational Research**
- What kind of kind of IRB review can you expect for your proposed study? What ethical considerations will the IRB want to discuss? What practical challenges will you have to meet in setting up your study?

**CTS 308 – 309: Introduction to Research Management I and II**
- What research resources will you need to obtain to perform this study? How will they impact the budget?
- What is Good Clinical Practice? What aspects of GCP apply to this project?
- What part of this project must be done by the PI? What can be done by a research manager? By other staff?

**CTS 315: Reporting Clinical & Translational Research**
- You have completed the proposed research. The abstract for your proposed study has been accepted at a national meeting. Describe the advantages and disadvantages of poster versus platform presentation formats. Please describe how to determine who should be included as an author on the manuscript. What are some of the problems or pitfalls that can arise in determining or negotiating authorship? How do you go about deciding what journal to submit to? Include discussion of the journal impact factor.

**CTS 320: Analyzing Clinical & Translational Research**
- In considering your written exam, describe your rationale for test choice and definition of variables. How do you interpret your results?

**CTS 325 Multivariate Methods for Clinical and Translational Research (Investigation and Surgery Tracks)**
In considering your written exam, interpret the coefficient and p value for pet ownership vs. pulse rate from the final model. Discuss your assessment of the model’s assumptions.

**Guidance for the Comprehensive Exam Committee**

**Approving the Research Question**

The purpose of approving the research question is to ensure that the Committee is aware of the question prior to the student submitting their written exam. The Committee should assume that the proposed research question is scientifically distinct from the thesis work (if applicable) and novel enough that the written exam could be submitted as a new R03. The Committee may clarify with the CTS Academic Advisor, Research Mentor or Internship Mentor if there are questions. Although the Committee may be tempted to assist the student in designing the written exam, students should complete their exam independently. The Committee should grant their approval to the student by email. If the Committee rejects the question, they must provide reasons. The student should work with the CTS Academic Advisor to propose a different or revised question.

**Grading**

The Comprehensive Exam Committee will discuss the student’s performance immediately following the oral exam. The Committee will evaluate both the written and oral exam. The Committee should consider, but is not limited to, the following questions in making their assessments:

- Is the student’s written and oral exam consistent with that expected at a master’s level and specific track (Investigation, Research Management)?
- Is the student’s discussion of research of high scientific quality?
- Within the scope of a master’s program, how well did the student describe and/or answer questions related to CTS core courses.

The exam grade outcomes are: Pass (no revisions), Provisional Pass (revisions required with defined time line), Fail. If revisions are required, the Chair will solicit comments from the other panel members and communicate them in writing to the student. The Chair will work with the student on a reasonable process and timeline for the revisions. In most cases, the student should be offered at least 30 days to make revisions. The final results will be sent to the Academic Advisor and CTS Program Specialist who will forward to the Graduate College.
CTS COMPREHENSIVE EXAM COMMITTEE MEMBERSHIP

Candidate’s Name ___________________________ Student ID ________________
Department ___________________________ Date of Exam: ________________
Phone(s) ___________________________ E-mail ________________

CTS Academic Advisor ___________________________ Dept ___________________________
Phone ___________________________ E-mail ________________

Research Mentor ___________________________ Dept ___________________________
Phone ___________________________ E-mail ________________

Committee Requirements: Committee consists of 3 members: 2 Key CTS Faculty Members and 1 Graduate College Faculty with content expertise who may or may not be Key CTS Faculty. The Research Mentor, CTS Academic Advisor, and any member of the Thesis/Dissertation Committee may not serve on the Comprehensive Exam. Students have a right to request certain faculty not be appointed to their Committee, per UVM Graduate College policy.

Refer to CTS policy on Key CTS Faculty definition and members.

Key CTS Faculty
Committee Member ___________________________ Campus Address ___________________________
Dept ___________________________ Phone ___________________________ E-mail ___________________________

Key CTS Faculty
Committee Member ___________________________ Campus Address ___________________________
Dept ___________________________ Phone ___________________________ E-mail ___________________________

Graduate College Faculty
Committee Member ___________________________ Campus Address ___________________________
Dept ___________________________ Phone ___________________________ E-mail ___________________________

Optional
Committee Member ___________________________ Campus Address ___________________________
Dept ___________________________ Phone ___________________________ E-mail ___________________________