Overview and Objectives:
This course will define Comparative Effectiveness Research (CER) and Patient-centered Outcomes Research (PCOR) and highlight the history and current national efforts in promoting CER for drugs, devices and other interventions. The curriculum will include topics on the conceptualization, outcome measurements, engagement of patients and stakeholders, study design issues, and analysis methods used in CER studies. The curriculum was developed for students to learn how to define a CER/PCOR research question and design a research project to answer the question. The teaching methods will be interactive with many sessions led by students.

Course Competencies:
1. Construct an innovative CER question that includes elements of the IOM and PCORI standards for CER.
2. Identify, critique, and compare research designs for your CER question.
3. Identify, compare, and critique analytical techniques specific to each CER research design.
4. Identify and integrate the elements of patient-centered outcomes into a CER study.
5. Identify sources of funding for CER.

The course format:
To maximize the utility of classroom discussions and associated exercises, the instructors expect that students complete all readings and assignments ahead of class and are prepared to discuss the assignments. Classroom lectures and activities will only briefly review the key concepts, and instead focus on expanding and applying concepts covered in the assignments.

1. For each topic, assigned readings and videos will provide the background material necessary to learn the topic. Please read and view the material prior to class and be prepared to participate in discussions. You will need the latest version of Flash player to view the assigned video presentations. Please note that you may need to adjust the volume while viewing the video clips in the presentations.
2. The majority of class time will be used for practical application of what has been covered in the assigned readings and videos. This will be done through evaluations; exercises using data; discussions; small group assignments; and other active learning methods.
3. Each class will start with an assessment on assigned material (readings, videos and other background material) and will contribute to the final course grade.

Team Science
CER/PCOR as most of science is done in teams and we will stress teamwork as part of the course as much as feasible. As part of this course, we will form peer teams of 5-6 individuals. Teams in general will discuss two areas: an exercise for that session or discussion of the projects. Each week a different member of the team will take these roles: 1. Facilitator: serves as the team leader; 2. Scribe: takes notes on discussion and summarize; 3. Presenter: presents the discussion, conclusions and controversies. We will devote time each week for each team to discuss each other’s projects and provide feedback to your peers. The teams will stay the same throughout the course so each member of the team becomes familiar with all the team projects and gets to know team members. This will allow learning about others projects, methods, PCOR elements, and analyses. A one-page summary of effective characteristics of team leaders and team members is provided in the courseweb.

Responsibilities:
Students will review pertinent papers for each session, lead discussions of assigned topics, participate in class and small group discussions, critique other students work, actively participate in the class, and complete online sessions independently.
Course Requirements:
- Attendance: The course is designed to be participatory; students need to be present at each class.
- Required readings and videos must be completed before class. Knowledge of the required assignments will be necessary for the assessments and to follow class discussion.
- Pre-class evaluations will consist of multiple choice questions. They will focus specifically on the assigned videos and/or reading assignments. Any questions about the evaluation should be directed to the instructor and emailed at least 24 hours before class starts. Assessments will be conducted at the beginning of class.
- For some of the sessions, in addition to the required readings, short summaries, or other assignments for the final CER proposal must be prepared in advance as described within each session and in the Course Grading Scale section.
- In-class discussions and exercises are needed to learn the material.

Attendance Policy:
Students are expected to sign in to each class (computer provided in suite lobby). If a problem is encountered with the sign-in system, please contact the course instructor as well as Juliana Tambellini (tambellijm2@upmc.edu) immediately.

Course Grading Scale: Letter grades
- 11 pre-class evaluations using clickers: 20% total (drop lowest 3; 2.5%/quiz)
- Turn in initial drafts of your research question for feedback (Sessions 2 and 4) and verbally present draft versions of your question, design, and engagement plan (Sessions 6, 9 and 12): 10% total
- Attendance and participation in class exercises (Sessions 1-5, 7-8, 10-11, 13-14): 20% total (allow 1 miss; 2%/class)
- A 4 page CER/PCOR proposal to develop a PCOR/CER study: 50% total (including the verbal presentation)

The proposal should have the following sections:
1. Overall Objective and Specific Aims. Aims should address a CER/PCOR question.
2. Significance. Show that the proposed research is important and a priority area of CER/PCOR.
3. Innovation. Show that the proposed study is novel and has the potential for high impact.
4. Improved Outcomes. Explain how the proposed research may enhance patient-centered outcomes.
5. Stakeholder Engagement. Show that the research represents a genuine collaboration between stakeholder groups that may include patients, caregivers, clinicians, and scientists and others as relevant.
6. Study Design. Justify that the study design is optimal, and feasible, for the given question.
7. Analytical Methods. Select and describe statistical methods that correspond to the selected research question, outcomes, and study design.

Course Mechanics: 2 Credits (2 hour/session, 2 sessions/week)

Required Textbooks: There is no textbook for this course. Required readings and videos to view are listed under each session.

Academic Integrity: Students in this course will be expected to comply with the University of Pittsburgh’s Policy on Academic Integrity (http://www.provost.pitt.edu/info/ai1.html). Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries, and programmable calculators.
Assignments and List of Sessions for CLRES Fall 2017:

**Resources:**
The UC-Davis CER (Video) Lessons: [https://cer.extensiononline.ucdavis.edu/](https://cer.extensiononline.ucdavis.edu/)
The Ohio State University CER Online Training modules: [https://cph.osu.edu/hopes/online-training-modules](https://cph.osu.edu/hopes/online-training-modules)
The following resource was developed by the Comparative Effectiveness Research Core; it serves as a useful resource for guiding the engagement of patients and stakeholders. [http://www.publichealth.pitt.edu/Portals/0/BIOSTAT/StakeholderEngagementGuide.pdf](http://www.publichealth.pitt.edu/Portals/0/BIOSTAT/StakeholderEngagementGuide.pdf)

**Overall Course Topic #1: Overview of, and fundamental approaches to CER and PCOR**
Sessions 1-6 introduce the concepts of CER and PCOR, the critical role of stakeholders, and fundamental concepts in design and analysis.

**Session 1.**
**Asking a PCOR/CER Question**

**GOALS:**
1. State the definition of CER and PCOR and discuss the strengths and limitations of CER/PCOR studies.
2. Review the history of CER/PCOR and describe the differences between CER and PCOR.
3. Describe the needs and challenges associated with national CER/PCOR priorities (e.g., IOM and PCORI).
4. Describe the elements of CER/PCOR questions.

**Assessment (Quiz) #1** will be given at the beginning of class on the following assignments.

**ASSIGNMENTS to complete before class:**
- **The Ohio State University CER Online Training Module 19:** Comparative Effectiveness Research 101.
- **Other Reading:** The PCORI Methodology Report. pg. 1-25. (which comes after the executive summary).
- **Discuss project with your team.** Come to class with a specific idea for a question you would like to propose on comparing two or more interventions, treatments or health systems.

**IN-CLASS ACTIVITY:**
- Lightening Rounds: present short methods from 10 studies with discussion about: 1. Is it CER? Is it PCOR; 3. Are any of the 6 elements in the study missing?
- Discuss a project proposal among your team members. Goal: develop a question and hypothesis that can be turned into specific aims.

**COMPETENCIES:** Propose significant and novel empirical, testable, hypothesis-driven research questions using, where appropriate, different disciplines and community engagement.

**Session 2.**
**Selecting your study design**

**GOALS:**
1. Summarize the study designs used in answering a CER/PCOR question.
2. Explain differences between randomized and observational study designs, and their limitations.
3. Identify and describe approaches to collecting observational data.
Assessment #2 will be given at the beginning of class on the following assignments.

ASSIGNMENTS to complete before class:

- UC-Davis CER Video Lesson #2 on History and Basic Elements of Randomized Clinical Trials – Slides 1-19 only.
- PCORI Methodology Standards Academic Curriculum. From Category 3: Standards for Data Integrity and Rigorous Analyses, watch the videos from Modules 3, 5a-b, and 7a.
- Project: Turn a brief description (of 2-3 sentences) of your research question. The instructors will provide feedback to you in the next class. Subsequent classes and assignments will build on this draft question and the corresponding feedback, so this is a short but important assignment.

IN-CLASS ACTIVITY:

- Teams will argue strengths and weaknesses of specific study designs for a given CER question.
- Discuss applications to your project proposal. Time will be reserved for questions about the project.

COMPETENCIES:

- Design basic features of research protocols based on specific research questions, appropriately addressing bias.
- Compare strengths and weaknesses of different research paradigms and methodologies.
- Identify appropriate study populations and sample size, control and comparison groups, and possible sources of bias for research problems.

Session 3.
Designing a Pragmatic Trial

GOALS:

1. Describe how pragmatic trials differ from explanatory trials, and the associated strengths and limitations.
2. Describe the design and implementation of pragmatic trials.

Assessment #3 will be given at the beginning of class on the following assignments.

ASSIGNMENTS to complete before class:

- UC-Davis CER Video Lesson #3 on Explanatory and Pragmatic Trials.
- Discuss Project with your team: There is no written assignment for your project this week. However, you should begin thinking about your specific aims and the main type of study design that would best answer your research question. For the next class, you will have to turn in a revised research question, specific aims, and a brief description of the study design.

IN-CLASS ACTIVITY:

- Evaluate studies using the PRECIS 2 diagram. You will be provided with studies to evaluate.
- Discuss applications to your project proposal.
- Instructors will leave time for open questions about the project proposal.

COMPETENCIES:

- Design basic features of research protocols based on specific research questions, appropriately addressing bias.
- Compare strengths and weaknesses of different research paradigms and methodologies.
- Identify appropriate study populations and sample size, control and comparison groups, and possible sources of bias for research problems.

**Session 4. Using Observational Data and Writing Analysis Plans**

**GOALS:**
1. Describe challenges in making inferences from observational data
2. Design non-experimental studies for CER
3. Develop an analysis plan for a given objective and study design.

**Assessment #4** will be given at the beginning of class on the following assignments.

**ASSIGNMENTS to complete before class:**
- **PCORI Methodology Standards Academic Curriculum. From Category 3:** Standards for Data Integrity and Rigorous Analyses, watch the videos from Module 7b.
- **PCORI Methodology Standards Academic Curriculum. From Category 8:** Standards for Causal Inference Methods, watch the videos from Modules 1-5.
- **Project:** Turn in a revised research question, with a listing of the proposed specific aims and a very brief description (of around 3 sentences) of the main study design.
  - The study design description should include 1) a statement of whether participants will be randomized or observed, 2) a brief justification of how the design is pragmatic, and 3) another sentence that either describes the randomization process (e.g. randomizing individual participants, or randomizing clusters or units) or the observational design (e.g. a prospective cohort, or a registry).
  - Propose a design that is feasible for you and your research group to conduct (now or in the near future) and try to be descriptive enough in your text so the reader gains some sense of how the study will be conducted in practice (while still being brief).

**IN-CLASS ACTIVITY:**
- Use example studies to assess pros and cons of observational and quasi-experimental designs and analysis plans.
- Discuss applications to your project proposal.
- Instructors will leave time for open questions about the project proposal.

**COMPETENCIES:**
- Design basic features of research protocols based on specific research questions, appropriately addressing bias.
- Compare strengths and weaknesses of different research paradigms and methodologies.
- Identify appropriate study populations and sample size, control and comparison groups, and possible sources of bias for research problems.

**Session 5. Developing and using registries**

**GOALS:** Describe how registries and clinical data networks are used in observational studies.

**Assessment #5** will be given at the beginning of class on the following assignments.

**ASSIGNMENTS to complete before class:**
- **PCORI Methodology Standards Academic Curriculum. Category 6:** Standards for Data Registries, watch all 8 Modules. Please note; each of these modules is fairly short – they are <1 hour total.

• **Project:** There is no assignment to turn in for your project this class, but you should work on revising the proposal based on verbal feedback from the last class.

• **Please select 1 article listed below under the in-class activity to review and discuss in class.**

  IN-CLASS ACTIVITY: Review research studies and identify strengths and limitations of the selected data sets. A template to guide discussion will be provided at Session 7. **Please select 1 article to review prior to class.**


**COMPETENCIES:**

- Design basic features of research protocols based on specific research questions, appropriately addressing bias.
- Compare strengths and weaknesses of different research paradigms and methodologies.
- Identify appropriate study populations and sample size, control and comparison groups, and possible sources of bias for research problems.

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**Session 6.**

**Student Presentations – Round 1: Presenting your question and design**

**GOALS:**

- Specify the question, specific aims, and basic design for your CER/PCOR project concept.

There will be **no assessment (quiz) this session.**

**ASSIGNMENTS to complete before class:**

- **Presentation:** Each trainee will have 5 minutes to present their concept.
- **Written Draft:** Use the previous feedback (from the last class) to edit the current version. Have a copy of this draft for the instructor to review as you are presenting your concept.
- **Do not prepare slides:** you will just verbally summarize your current draft of the idea, the specific aims, and the fundamental design. We do not expect significant details in writing, but we do expect that you will use the previous feedback to formulate a strong idea at this point in the class.

**IN-CLASS ACTIVITY:** Class presentations.

**COMPETENCIES:** Prepare and deliver oral presentations of research at a variety of stages to a range of audiences, and respond to constructive criticism and questions.

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**Session 7.**

**Engaging stakeholders**

**GOALS:**

1. Define the role stakeholders in CER/PCOR and discuss how their involvement can occur in all phases of research.
2. Analyze methods of obtaining, incorporating, and evaluating stakeholder input in CER/PCOR
3. Differentiate the role of research subject, advisor, and stakeholder.
4. Summarize ways that stakeholder input is important in designing CER/PCOR studies.
5. Recognize the role of stakeholders in the implementation stage of research.

Assessment #6 will be given at the beginning of class on the following assignments.

ASSIGNMENTS to complete before class:

- **PCORI Methodology Standards Academic Curriculum. Category 2:** Standards Associated with Patient-Centeredness, watch the videos from Module 4.

- Also review the following documents:
  - PCORI Engagement Plan Template; go to Section F on page 4 of the [Research Plan Template](http://www.pcori.org/sites/default/files/Research-Plan-Template.pdf).
- **Project:** There is no assignment to turn in for your project this class, but you should begin preparing a brief presentation for the next class based on the feedback you will receive in this class. Keep in mind, you will need to turn in both the revised written version (with the same components as you turned in the last time) and you will make a brief verbal presentation (prepare 5 minutes *without* slides – just describe the idea from your brief draft).

IN-CLASS ACTIVITY:

- Use the worksheet provided (in courseweb) to optimally describe the engagement approach. We will review selected figures/tables from example papers and discuss a case study.
- Students work to develop and discuss their own stakeholder engagement plans.

COMPETENCIES:

- Recognize the impact of diverse populations and local demography on research designs, and modify research design accordingly.

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**Overall Course Topic #2: Further Design and Analysis Strategies**

Sessions 7-12 describe more in-depth approaches for designing and analyzing CER studies.

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**Session 8. Collecting Qualitative Data**

**GOALS:**

1. Explain the key elements needed for strong qualitative research
2. Clarify the unique requirements for mixed methods.
3. List minimum criteria for assessing strengths and weakness for qualitative research and mixed methods studies.

Assessment #7 will be given at the beginning of class on the following assignments.

ASSIGNMENTS to complete before class:

- **PCORI Methodology Report:** Beginning of Section II on Prioritizing Research Questions. Pages 11-15 and Section III.2 on Standards Associated with Patient-Centeredness. Pages 27-34.
- **Reading:** The first reading assignment is a (December 2001) report is from the Office of Behavioral and Social Sciences Research, National Institutes of Health. Bethesda, MD. NIH Publication No. 02-5046. [https://obssr.od.nih.gov/pdf/Qualitative.pdf](https://obssr.od.nih.gov/pdf/Qualitative.pdf)

• **Project:** There is no assignment to turn in for your project this class, but you should begin preparing a brief presentation for the next class based on your previous draft, the feedback you’ve received, and a short plan for stakeholder engagement. As we did previously, you will need to turn in both the revised written version (which has the previous components + an engagement plan) and you will make a brief verbal presentation (prepare 5 minutes *without* slides – just describe the idea from your brief draft).

**IN-CLASS ACTIVITY:**
- Discuss examples and approaches to qualitative data collection, with applications to student projects.

**COMPETENCIES:**
- Recognize the impact of diverse populations and local demography on research designs, and modify research design accordingly.

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**Session 9.**

**Presentations – Round 2: Presenting your Engagement Plan**

**GOALS:** Propose an approach for stakeholder engagement for your CER/PCOR project concept.

There will be *no assessment (quiz) this session.*

**ASSIGNMENTS to complete before class:**

- **Presentation:** Each trainee will have 5 minutes to present their concept.
- **Written Draft:** Use the feedback so far to edit your research question and the fundamental design (as needed) and add a brief (3-4 sentence) description of the engagement plan. Have a copy of this draft for the instructor to review as you are presenting your concept.
- **Do not prepare slides:** you will just verbally summarize your current draft of the idea, the specific aims, the fundamental design, and the engagement plan. We do not expect significant details in writing, but we do expect that you will use the previous feedback to incorporate needed revisions.

**IN-CLASS ACTIVITY:** Class presentations.

**COMPETENCIES:**
- Prepare and deliver oral presentations of research at a variety of stages to a range of audiences, and respond to constructive criticism and questions.

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**Session 10.**

**Making Causal Inferences**

**GOALS:**

1. Review the fundamental challenges associated with causal inference from observation designs
2. Describe the concept of a propensity score and methods for using adjustment, matching and weighting
3. Describe the concept of, and possible measures to represent an instrumental variable
4. Describe a process for selecting the appropriate method for a given problem

**Assessment #8** will be given at the beginning of class on the following assignments.

**ASSIGNMENTS to complete before class:**

- **UC-Davis CER Video Lesson #15** on Instrumental Variables and Propensity Scores.
- **PCORI Methodology Standards Academic Curriculum. Category 3:** Standards for Data Integrity and Rigorous Analyses, watch the videos from Module 4.
- **PCORI Methodology Standards Academic Curriculum. Category 8:** Standards for Causal Inference Methods, watch the videos from Modules 6a-6a, 7a-7b.
• **Project:** There is no assignment to turn in for your project this class, but you should work on revising the proposal based on verbal feedback from the last class.

**IN-CLASS ACTIVITY:**
• The in-class session will focus on deciding which method is best for which problem and implementing these methods in practice using Stata.
• Discuss applications to the analysis plan of your project proposal.

**COMPETENCIES:**
• Design basic features of research protocols based on specific research questions, appropriately addressing bias.
• Compare strengths and weaknesses of different research paradigms and methodologies.

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### Session 11.
**Assessing Treatment Heterogeneity**

**GOALS:**
1. Describe the goals of personalized medicine and how the usual assessment of treatment effectiveness assesses average rather individualized treatment effects.
2. Describe the challenges of applying CER/PCOR findings to individual patients or subgroups.

**Assessment #9** will be given at the beginning of class on the following assignments.

**ASSIGNMENTS to complete before class:**
• **UC-Davis CER Video Lesson #4** on Evidence Based Medicine, Heterogeneity of Treatment Effects, and the Trouble with Averages.
• **PCORI Methodology Standards Academic Curriculum. Category 5:** Standards for Heterogeneity of Treatment Effects, watch the videos from Modules 1-3, and 8.
• **Project:** There is no assignment to turn in for your project this class, but you should begin preparing a brief presentation for the next class based on your previous draft, the feedback you’ve received, and a short draft of the analysis plan (3-4 sentences). As we did previously, you will need to turn in both the revised written version (which has the previous components + an analysis plan) and you will make a brief verbal presentation (prepare 5 minutes without slides – just describe the idea from your brief draft).

**IN-CLASS ACTIVITY:**
• Evaluate published projects and assess their approach to HTE.
• Discuss applications to your project proposal.
• Instructors will leave time for open questions about the project proposal.

**COMPETENCIES:**
• Identify appropriate study populations and sample size, control and comparison groups, and possible sources of bias for research problems.
• Recognize the impact of diverse populations and local demography on research designs, and modify research design accordingly.
Session 12.
Presentations – Round 3: Presenting your Methods

GOALS: Propose an approach for stakeholder engagement for your CER/PCOR project concept.

There will be no assessment (quiz) this session.

ASSIGNMENTS to complete before class:

- **Presentation**: Each trainee will have 5 minutes to present their concept.
- **Written Draft**: Use the feedback so far to edit your research question, fundamental design, and engagement plan (as needed) and add a brief (3-4 sentence) description of the analysis plan. Have a copy of this draft for the instructor to review as you are presenting your concept.
- **Do not prepare slides**: you will just verbally summarize your current draft of the idea, the specific aims, the fundamental design, and the engagement plan. We do not expect significant details in writing, but we do expect that you will use the previous feedback to incorporate needed revisions.

IN-CLASS ACTIVITY: Class presentations.

COMPETENCIES:

- Prepare and deliver oral presentations of research at a variety of stages to a range of audiences, and respond to constructive criticism and questions.

Overall Course Topic #3: Additional Methods and Final Presentations.

Sessions 13-16 will describe additional methodological approaches for CER and PCOR, and students will present their final project proposal.

Session 13.
Systematically assessing the literature

GOALS:

- Summarize systematic reviews and meta-analyses methods and their role in CER/PCOR.

Assessment #10 will be given at the beginning of class on the following assignments.

ASSIGNMENTS to complete before class:

- **UC-Davis CER Video Lesson #16** on Systematic Review and Meta-analysis.
- **UC-Davis CER Video Lesson #18** on Analyzing, Interpreting and Presenting the Results.
- **Project**: There is no assignment to turn in for your project this class, but you should be working on expanding your project proposal to include all required components for the final proposal (see page 2 of the syllabus; the required sections also listed under ASSIGNMENTS in the final session).

IN-CLASS ACTIVITY:

- Develop a potential question for a systematic review, to be discussed during class.
- Small group discussion of a possible question for a systematic review. Groups will refine the question, including 1) inclusion and exclusion criteria, and 2) primary and secondary outcomes, and discuss results.
- Small group discussion of 1-2 RCTs; groups will assess risk of bias and complete the Risk of Bias table, rating each domain as “low,” “unclear,” or “high”, and discussing results with the class.

COMPETENCIES:

- Design basic features of research protocols based on specific research questions, appropriately addressing bias.
- Compare strengths and weaknesses of different research paradigms and methodologies.

Session 14.
Designing More Advanced Trials
GOALS: This session focuses on introducing some advanced designs for patient-centered CER. These trials are novel but increasing in popularity. These designs have substantial complexity in terms of their analytical considerations, but we will not go into detail. Instead, this session will serve as an introduction to motivate and describe the use of these designs.

- Describe what an adaptive design is, and some key aspects of their associated variations, strengths, and limitations.
- Describe other advanced trials, and what we can gain by using these trials for CER.
- Describe key reporting issues.

Assessment #11 will be given at the beginning of class on the following assignments.

ASSIGNMENTS to complete before class:
- PCORI Methodology Standards Academic Curriculum. Category 9: Standards for Adaptive and Bayesian Trial Designs, watch the videos from Modules 1, 4, 7, and 8.
- Project: There is no assignment to turn in for your project this class, but you should be working on expanding your project proposal to include all required components for the final proposal (see page 2 of the syllabus; the required sections also listed under ASSIGNMENTS in the final session).

IN-CLASS ACTIVITY:
- In the live session we will discuss specific examples of adaptive trials for CER.
- Discuss applications to your project proposal.

COMPETENCIES:
- Design basic features of research protocols based on specific research questions, appropriately addressing bias.
- Compare strengths and weaknesses of different research paradigms and methodologies.

Sessions 15-16.
Presentations – Round 3: Presenting the Final Proposal
GOALS: Present final CER/PCOR project proposal.

ASSIGNMENTS to complete before class:
- Presentation: Each trainee will have 10 minutes to present their concept and respond to questions. E-mail the slides to Dr. Landsittel by Monday night, October 31.
- Written Draft Project Proposal: Turn in your final proposal (3-4 pages) with the following required components.
  1. Overall Objective and Specific Aims. Aims should address a CER/PCOR question.
  2. Significance. Show that the proposed research is important and why the question is a priority area of CER/PCOR
  3. Innovation. Show that the proposed study is novel and has the potential for high impact.
  4. Improved Outcomes. Explain how the proposed research may enhance patient-centered outcomes.
  5. Stakeholder Engagement. Show that the research represents a genuine collaboration between stakeholder groups that may include patients, caregivers, clinicians, and scientists and others as relevant.
  6. Study Design. Justify that the study design is optimal, and feasible, for the given question.
  7. Analytical Methods. Select and describe statistical methods that correspond to the selected research question, outcomes, and study design.

IN-CLASS ACTIVITY: Class presentations over 2 classes.

COMPETENCIES:
- Prepare and deliver oral presentations of research at a variety of stages to a range of audiences, and respond to constructive criticism and questions.
• Prepare written presentations of research at a variety of stages to a range of audiences, technical and non-technical, and respond to constructive criticism and questions.