We apply epidemiology and neuroimaging methodologies in population and clinical studies to promote etiological research and evaluation of treatment for the disorders of the central nervous system that affect aging. Our focus is currently on vascular factors and physical activity to improve brain health and function in sedentary and frail older adults, specifically in hippocampal and prefrontal areas.

Pi of the eBRAIN: Caterina Rosano, MD, MPH
car2350@pitt.edu
Specialization in Neuroepidemiology

The department of Epidemiology at the School of Public Health offers a Specialization in Neuroepidemiological translational research to elucidate the etiology of disorders of the central nervous system. Eligible applicants are:

a) PhD graduates in Epidemiology, Psychology, Neuroscience, Biostatistics, Computer Science, Biomedical Engineering and other related disciplines who seek additional training in Neuroepidemiology;  
b) Physicians with training in Neurology, Psychiatry, Neuroradiology, Neurosurgery, Geriatric medicine, Physical medicine and Rehabilitation and related disciplines.  
c) Candidates in the PhD or MD/PhD programs as above.  
d) Individuals with prior health-related professional degrees enrolled in the Master Program in Epidemiology.

1. Overview:

The etiology of many important disorders of the central nervous system remains elusive. For some diseases, like stroke, the most important risk determinants have been identified but better prevention and therapeutic approaches are needed to reduce the continued high incidence and mortality, especially in selected racial, ethnic and socioeconomic groups.  

The evolving new technologies for studying disease etiology, pathologies and host susceptibility provide potential opportunities to define these conditions, understand their etiology, and respond with effective prevention and treatments. Specifically, the application of advanced methodology can facilitate the phenotype’s characterization earlier in the course of the disease, can improve causal inference in observational epidemiological studies, and can enable accurate monitoring of response to therapy.  

Evolving technologies alone are not sufficient to advance our understanding of the etiology and pathogenesis of disorders of the central nervous system. It is essential to understand how to apply such technology in the context of carefully characterized populations (especially those with larger sample size and unique characteristics, i.e. higher or lower incidence of disease), that are followed in studies which are rigorously conducted and designed.  

The Neuroepidemiology program addresses this challenge by building on three pillars or cores: multimodal assessment of neurological conditions, epidemiological methods and advanced statistical analyses. The reason for these 3 cores is based on the observation that knowledge of methodological central nervous system assessment is key to define the clinical manifestations of neurological diseases and to identify related risk factors and biomarkers, whereas knowledge of study design and statistical testing are key to quantify a disease frequency through careful ascertainment of cases within the population at risk and provide morbidity and mortality rates. Moreover, the rapid advancement of technology continues to yield ever greater amounts of data which require careful data mining approaches.

2. Goal and Objectives:

The goal of this program is to prepare independent investigators from a variety of disciplines to conduct independent epidemiological studies to discern the etiologic factors and underlying mechanisms that influence the onset, progression and recurrence of disorders and diseases affecting the central nervous system (CNS). The program has four specific objectives:

1. **Define the conditions:** critically evaluate the most recent methodologies to quantify burden of CNS disorders;  
2. **Understand the mechanisms:** apply advanced methods to estimate the role of demographic factors and of biomarkers to predict susceptibility and risk of developing neurological diseases, as well as variability of clinical manifestations, of survival and of response to treatment;  
3. **Respond:** Design novel studies to prevent the onset, delay the progression and improve the response to therapies.  
4. **Disseminate:** Share research findings with the public health community, health care professionals and scientists engaged in neurological diseases studies.
3. Course Requirements:
Students will complete the course requirements in three cores.

<table>
<thead>
<tr>
<th>Neuroepidemiology Core</th>
<th>Credits</th>
<th>Completed</th>
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<tbody>
<tr>
<td>EPIDEM2012 Principles in Neuroepidemiology</td>
<td>2</td>
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Students without prior background in neurophysiology, neuroanatomy and neuroscience can attend this course upon approval of the instructor.

<table>
<thead>
<tr>
<th>Epidemiology Methods Core</th>
<th>Credits</th>
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<tr>
<td>EPIDEM 2110 Principles of Epidemiology</td>
<td>3</td>
<td></td>
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<tr>
<td>EPIDEM 2180 Epidemiologic Methods 1</td>
<td>3</td>
<td></td>
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<tr>
<td>EPIDEM 2181 Design of Clinical Trials</td>
<td>2</td>
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</table>

Courses can be transferred from other degrees upon approval of the instructor and they must cover: Diagnostic and Screening Tests, including Evaluation of diagnostic tests (sensitivity, specificity, ROC curves); Study Design (e.g.: Observational Cohort, Case-control, Clinical Trials); Assessment of Causal inference, confounding (methods for assessing/controlling such as matching, stratification), effect modification (interaction, mediation etc); Survey sampling methods; Validity and reliability testing; Sources of study bias: selection bias, nonresponse bias, measurement error.

<table>
<thead>
<tr>
<th>Advanced Statistical Analyses Core</th>
<th>Credits</th>
<th>Completed</th>
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<tr>
<td>BIOST 2041 Introduction to Statistical Methods 1</td>
<td>3</td>
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</tr>
<tr>
<td>BIOST 2042 Introduction to Statistical Methods 2</td>
<td>3</td>
<td></td>
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<tr>
<td>PSYED 2422 Data Analysis Using Computer Packages</td>
<td>3</td>
<td></td>
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<tr>
<td>BIOST 2049 Applied Regression Analysis</td>
<td>3</td>
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Courses can be transferred from other degrees upon approval of the instructor and they must cover: Pre-requisite knowledge in Data analysis include: Sample size and power calculation; Cost-effectiveness Analysis; Quality control, methods for reducing measurement error; Guide to statistics and database software; Database management (structures, design, reporting and query operations).

4. Research Practicum Requirement:
The Research Practicum contributes to at least 4 credits and can count toward the Thesis/Dissertation for those enrolled in a degree program. The objective of these rotations is to conduct original neuroepidemiological research that will produce publishable results and collect data to build a grant proposal. The Research Practicum is mentored by a preceptor; it focuses on a “thematic area” identified by the trainee and includes analysis of existing data (Data analysis rotations) or generation of new data (Data collection Rotations). In Data Analysis rotations trainees learn to analyze existing neuroepidemiological databases, including neuroimage processing and secondary data analyses. Experience will include direct manipulation of data including drafting of statistical analysis code. In Data Collection Rotations, the trainees actively participate conducting research including design, start-up, recruitment, measurements, data management. One Research Rotation is required for all, although trainees are strongly encouraged to participate to primary data collection. One manuscript and related presentation are required. Through the practicum, the trainees will:
- Apply concepts taught in formal classes
- Learn practical aspects of conducting research, including how to work within a multidisciplinary team;
- Produce publishable results through independent data analysis;
- Contribute to launch new projects with potential for developing into new grant research proposal.

5. Other requirements:
5.1. Epi-Brain Journal Club. This monthly journal club is led by the trainees with supervision of the instructor(s). The goal of this journal club is to provide the trainees with a critical understanding on the literature in fields related to Neuroepidemiology. Articles will be chosen by the trainees with the guidance of the instructors to explore the application of neuroimaging methods in the context population studies with focus on the aging brain. The Journal Club draws on expertise in Epidemiology, Psychiatry, Psychology, Rehabilitation Sciences, Biomedical Engineering and Neuroscience. Each student is required to attend at least 80% of the sessions and to present one or more articles. Journal Club sessions take place on the third Monday of each month from 9:45 am – 10:45 am at the Eye and Ear Institute, Room 523.

5.2. Independent Study in Neuroimaging: A 6-week summer workshop is offered at the Carnegie Mellon University. Two positions are open to trainees every year. Applications to receive coverage of all expenses need to be submitted by November of the year prior to the workshop. The workshop provides training in multiple imaging modalities, DTI, functional MRI, PET, MEG/EEG, functional Near IR Spectroscopy and Animal Optical Imaging.