**GTPCI Fall 2022 Curriculum Retreat and Post-Retreat Summary**

Johns Hopkins Mt. Washington Campus

December 14, 2022 - 8:30 am to 1:00 pm

**Participants Were:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Data Science** | **Clinical Trials** | **Health Services Research** | **Pathogenesis** |
| Jessica Ruck | Daniel Ford | Jack Iwashyna | Elias Sotirchos |
| Abimereki Muzaale | Marie Diener-West | Tiffany Mark | Joe Bienvenu |
| Bill Werbel | Dale Needham | Allan Gelber | Frank Adkinson |
| Rachel Wallwork | Julie Hoover-Fong | Halima Amjad | Yumeng Wen |
| Charlie Flexner | Elisa Ignatius | Karen Bandeen-Roche | Mela Bembea |
| Abdulla Damluji | Sapna Kudchadkar |  |  |
| Aly Strauss | Betsy King |  |  |
| Mickey Eagleson | Pete Miller |  |  |
|  | Abin Puravath |  |  |

**SUMMARY**

GTPCI Pathways for MHS and PhD Trainees

Effective August 2023, The GTPCI is introducing four academic pathways for MHS and PhD trainees: Data Science (including machine learning and artificial intelligence), Disease Oriented Studies, Health Services Research, and General Clinical Investigation (including clinical trials).

The field of clinical investigation has expanded since GTPCI started in 1993. The goal of introducing these pathways is to allow trainees more flexibility to choose coursework relevant to their academic interests.

The **General Clinical Investigation** pathway’s goal is to teach trainees key principles necessary for the conduct of clinical studies, including development of research questions and appropriate study designs, research protocols, consent statements, monitoring plans, and data collection plans. Trainees who choose the General Clinical Investigation pathway are those interested in a career focusing on clinical trials, or areas of investigation that do not fall within data science, disease-oriented studies, and health services research.

Trainees who choose the **Disease-Oriented Studies** pathway are those interested in linking a basic pathophysiological mechanism, with a risk for disease, or the development of an intervention targeting that disease. Such research is sometimes referred to as ‘translational research’.

**Data science** combines medical domain expertise with math and statistics, specialized programming, advanced analytics, and in some cases, artificial intelligence (AI), and machine learning to uncover actionable insights in biomedicine. Trainees who choose the Data Science pathway will create a learning plan to achieve the required skills necessary to interrogate large databases and uncover insights from big data.

**Health Services Research** is the field of scientific investigation that examines how social factors, organizational structures and processes, financing systems, technologies, and behaviors affect multiple facets of health and healthcare. The goals of the Health Services Research pathway are to guide trainees in formulating an approach that is nested within economic or sociological theory, to answer research questions using a contemporary approach to causal inference, and to teach trainees skills in the analysis of cost, utilization, and value.

Applicants may designate a specific pathway in their initial GTPCI application or may consult members of the GTPCI academic committee after acceptance into the GTPCI program for guidance in choosing an appropriate pathway that is congruent with their academic pursuits.

**FOUNDATIONAL COURSES**

Trainees in all 4 pathways must take the following “*foundational courses*” (a total of 51 credits).

|  |  |  |  |
| --- | --- | --- | --- |
| ***1st Term      September-October     17 Credits*** | | | |
| 340.751.41  340.951 | 5 | **Epidemiologic Methods I**  **Epi Labs** | M W F 9:00-11:50 Hybrid: lectures and labs - on-campus and synchronous online |
| 140.621.81  140.921 | 4 | **Statistical Methods in Public Health I**  **Biostat Labs** | Online asynchronous lectures  Options for synchronous labs  Live Talks every Tues 7-8:30 pm |
| 550.600.41 | 1 | **Living Science Ethics/Responsible Conduct Research** | W 4:00-5:00 Hybrid: synchronous via Zoom and online asynchronous lectures |
| 550.860.82 | 0 | **Academic Research Ethics** | Online asynchronous |
| 390.631.01 | 2 | **Principles of Drug Development** | W 1:30-2:50 On-campus |
| 390.751.71 | 2 | **Seminars in Clinical Investigation I** | M 1:30-2:50 Synchronous via Zoom |
| 390.673.01\*\* | 3 | **Ethical & Regulatory Issues in Clinical Research** | M 5:30-8:30 On-campus |
| ***2nd Term      October-December    13 Credits*** | | | |
| 340.752.41  340.952 | 5 | **Epidemiologic Methods II**  **Epi Labs** | M W F 9:00-11:50 Hybrid: lectures and labs - on-campus and synchronous online |
| 140.622.81  140.922 | 4 | **Statistical Methods in Public Health II**  **Biostat Lab** | Online asynchronous lectures  Options for synchronous labs  Live Talks every Tues 7-8:30 pm |
| 390.752.71 | 2 | **Seminars in Clinical Investigation II** | W 1:30-2:50 Synchronous via Zoom |
| 390.710.60 OR .62 | 2 | **Biomedical Writing I**  (2 sections .60 & .62 – choose best time for you) | Th 8:30-10:20 OR T 3:30-5:20  Hybrid: 6 synchronous sessions via Zoom/2 on-campus sessions |
| ***3rd Term      January-March     11 Credits*** | | | |
| 340.753.01  340.953 | 5 | **Epidemiologic Methods III**  **Epi Labs** | M W F 9:00-11:50 Hybrid: lectures and labs - on-campus and synchronous online |
| 140.623.81  140.923 | 4 | **Statistical Methods in Public Health III**  **Biostat Labs** | Online asynchronous lectures  Options for synchronous labs |
| 390.721.71 | 2 | **Grant Writing and Presentation Skills I** | Th 8:30-10:20 Synchronous via Zoom |
| ***4th Term     March-May           10 Credits*** | | | |
| 140.624.41 | 4 | **Statistical Methods in Public Health IV** | Online asynchronous lectures  Options for synchronous labs |
| 390.722.71 | 4 | **Grant Writing and Presentation Skills II** | M 1:30-5:20 Synchronous via Zoom |
| 390.711.60 OR .62 | 2 | **Biomedical Writing II**  (2 sections .60 & .62 – choose best time for you) | T 1:30-3:20 OR W 10:00-11:50  Hybrid: 6 synchronous sessions via Zoom/2 on-campus sessions |

The remaining credits necessary to complete the MHS degree (a total of 70 credits) and the PhD degree (registration for at least 16 credits for 4 consecutive terms then 5 additional courses in years 2/3) will be obtained from the required and elective courses within each pathway as summarized below.

**General Clinical Investigation Pathway**

***Description***

The **General Clinical Investigation** pathway’s goal is to teach trainees key principles necessary for the conduct of clinical studies, including development of research questions and appropriate study designs, research protocols, consent statements, monitoring plans, and data collection plans. Trainees who choose the **General Clinical Investigation** pathway are those interested in a career focusing on clinical trials, or areas of investigation that do not fall within data science, disease-oriented studies, and health services research.

***Pathway-Specific Competencies***

***MHS***

* Identify key principles for the development of protocols, consent statements, monitoring plan, and data collection plan for clinical trials

***PhD***

* Develop research questions, design studies, and create protocols that ensure the safety of study participants and the accuracy and reliability of data.
* Collect, manage, and analyze research data using appropriate methods and tools, ensuring the accuracy and completeness of the data, and maintaining data privacy and confidentiality

***Pathway-Specific Courses***

***Required MHS Courses:***

*We strongly recommend the following courses:*

**340.645** Introduction to Clinical Trials (3 credits)

**340.694** Power & Sample Size for the Design of Epidemiological Studies (1 credit)

**340.861** Clinical Trials: Procedures, Design, and Interpretation of Results (3credits)

***Required PhD Courses:***

**340.645** Introduction to Clinical Trials (3 credits)

**340.694** Power & Sample Size for the Design of Epidemiological Studies (1 credit)

**340.861** Clinical Trials: Procedures, Design, and Interpretation of Results (3credits)

**140.642** Design of Clinical Experiments (3 credits)

**340.606** Methods for Conducting Systematic Reviews and Meta-analyses (3 credits)

Strongly Recommended: **340.648** Clinical Trials Management (3 credits)

Strongly Recommended: **340.633** Data Management in Clinical Trials (3 credits)

Strongly Recommended: **340.660** Practical Skills in Conducting Research in Clinical Epidemiology and Investigation (3 credits)

***Electives***

**140.655** Analysis of Longitudinal Data (3 credits)

**140.641** Survival Analysis (3 credits)

**340.706** Methods and Applications of Cohort Studies (2 credits)

**340.728** Advanced Methods for Design and Analysis of Cohort Studies (5 credits)

**140.642** Design of Clinical Experiments (3 credits)

**340.606** Methods for Conducting Systematic Reviews and Meta-analyses (3 credits)

**340.648** Clinical Trials Management (4th term)

**340.633** Data Management in Clinical Trials (3 credits)

**340.660** Practical Skills in Conducting Research in Clinical Epidemiology and Investigation (3 credits)

**140.664** Causal Inference in Medicine and Public Health (3credits)

**223.664** Design and Conduct of Community Trials (4 credits)

**223.690** The Design and Analysis of Cluster Randomized Trials (2 credits)

**223.705** Good Clinical Practice: A Vaccine Trials Perspective (4 credits)

**340.671** Topics in Management of Clinical Trials (2 credits)

**340.676** Bayesian Adaptive Trials (2 credits)

**223.662** Vaccine Development and Application (4 credits)

**140.633** Biostatistics in Medical Product Regulation (2 credits)

**340.682** Pharmacoepidemiology Methods (3 credits)

**340.684** Pharmacoepidemiology: Drug Utilization (3 credits)

**340.619** Topics in Pharmacoepidemiology (2 credits)

**390.631** Principles of Drug Development (2 credits)

*Courses offered outside of BSPH: Students must obtain written permission from instructors*

**AS.410.649** Introduction to Regulatory Affairs (4 credits)

**AS.410.676** Food and Drug Law (3 credits)

**Additional Suggestions**

The Seminars in Clinical Investigations should include 1-2 session that are pathway specific in which students do different things based on their pathway. Clinical trials specific seminars could focus on role/ responsibility of DSMB, budget development for clinical trials, FDA site visit, sit-in on FDA/IND panel meetings.

The Clinical Trials pathway PhD students would be eligible to apply for apprenticeship within the NIH Clinical Trials program which would be a more intensive year-long experience***.***

**Disease-Oriented Studies Pathway (Translational Disease-Specific Pathway)**

***Description***

Trainees who choose the **Disease-Oriented Studies** pathway are those interested in linking a basic pathophysiological mechanism, with a risk for disease, or the development of an intervention targeting that disease. This pathway may also be referred to as the ‘Translational Disease-Specific Pathway’.

***Pathway-Specific Competencies***

***MHS***

Demonstrate understanding of the stages of translational research, from discovery to implementation

***PhD***

Design research studies that are relevant to your disease of interest and have potential impact on patient outcomes

Collaborate effectively with interdisciplinary teams, including basic scientists, clinicians, and/or industry partners

***Pathway-Specific Courses***

***MHS***

None

***PhD***

None

***Electives***

**340.731** Principles of Genetic Epidemiology 1 (4 credits)

**340.732** Principles of Genetic Epidemiology 2 (3 credits)

**340.733** Principles of Genetic Epidemiology 3 (3 credits)

**340.734** Principles of Genetic Epi 4: Emerging and Advanced Methods (2 credits)

**187.633** Introduction to Environmental Genomics and Epigenomics (3 credits)

**140.688** Statistics for Genomics (3 credits)

**140.630** Introduction to Data Management (3 credits)

**140.656** Multilevel Statistical Models in Public Health (4 credits)

**140.655** Analysis of Longitudinal Data (4 credits)

**140.641** Survival Analysis (3 credits)

**340.706** Methods and Applications of Cohort Studies (2 credits)

**340.728** Advanced Methods for Design and Analysis of Cohort Studies (5 credits)

**340.606** Methods for Conducting Systematic Reviews and Meta-Analyses (4 credits)

**140.664** Causal Inference in Medicine and Public Health I (4 credits)

**140.665** Causal Inference in Medicine and Public Health II (3 credits)

**140.711** Advanced Data Science I (3 credits)

**140.712** Advanced Data Science II (3 credits)

**140.642** Design of Clinical Experiments (3 credits)

**340.645** Introduction to Clinical Trials (3 credits)

**340.694** Power & Sample Size for the Design of Epidemiological Studies (1 credit)

**340.861** Clinical Trials: Procedures, Design, and Interpretation of Results (3credits)

**140.642** Design of Clinical Experiments (3 credits)

**340.606** Methods for Conducting Systematic Reviews and Meta-analyses (3 credits)

**340.648** Clinical Trials Management (3 credits)

**340.633** Data Management in Clinical Trials (3 credits)

**340.660** Practical Skills in Conducting Research in Clinical Epidemiology and Investigation (3 credits)

**223.662** Vaccine Development and Application (4 credits)

**140.633** Biostatistics in Medical Product Regulation (2 credits)

**340.682** Pharmacoepidemiology Methods (3 credits)

**340.684** Pharmacoepidemiology: Drug Utilization (3 credits)

**340.619** Topics in Pharmacoepidemiology (2 credits)

**390.631** Principles of Drug Development (2 credits)

**Data Science Pathway**

***Description***

**Data science** combines medical domain expertise with math and statistics, specialized programming, advanced analytics, and in some cases, artificial intelligence (AI), and machine learning to uncover actionable insights in biomedicine. Trainees who choose the Data Science pathway will create a learning plan to achieve the required skills necessary to interrogate large databases and uncover insights from big data.

***Pathway-Specific Competencies***

***MHS***

* Describe rigorous, responsible, and reproducible data use management techniques
* Formulate analytical plans for big data

***PhD***

* Develop a protocol for data management and storage that ensures compliance with regulatory requirements and promotes transparency and reproducibility
* Formulate analytical plans for big data
* Analyze various data types (e.g., omics, EHR, imaging) and/or large datasets

***Pathway-Specific Courses***

*Required Courses for MHS*

None

*Required Courses for PhD*

None

*Suggested Electives*

**140.655** Analysis of Longitudinal Data (4 credits)

**140.641** Survival Analysis (3 credits)

**340.706** Methods and Applications of Cohort Studies (2 credits)

**340.728** Advanced Methods for Design and Analysis of Cohort Studies (5 credits)

**340.606** Methods for Conducting Systematic Reviews and Meta-Analyses (4 credits)

**340.696** Spatial Analysis I: ArcGIS (3 credits)

**140.628** Data Science for Public Health I (4 credits)

**140.629** Data Science for Public Health II (4 credits)

**140.644** Statistical Machine Learning: Methods, Theory, and Applications (4 credits)

**140.664** Causal Inference in Medicine and Public Health I (4 credits)

**140.665** Causal Inference in Medicine and Public Health II (3 credits)

**140.644** Statistical Machine Learning: Methods, Theory, and Applications (4 credits)

**140.646** Essentials of Probability and Statistical Inference I: Probability (4 credits)

**140.647** Essentials of Probability and Statistical Inference II: Statistical Inference (4 credits)

**140.648** Essentials of Probability and Statistical Inference III: Theory of Modern Statistical Methods (4 credits)

**140.649** Essentials of Probability and Statistical Inference IV (4 credits)

**140.776** Statistical Computing (3 credits)

**140.711** Advanced Data Science I (3 credits)

**140.712** Advanced Data Science II (3 credits)

**390.631** Principles of Drug Development (2 credits)

*The following electives are outside of BSPH. Please contact the instructors to get permission to register:*

**EN.520.412** Machine Learning for Signal Processing (3 credits)

**EN.520.447** Introduction to Information Theory and Coding (3 credits)

**EN.601.475/675** Machine Learning (3 credits)

**EN.601.464/664** Artificial Intelligence (3 credits)

**EN.605.649** Introduction to Machine Learning (3 credits)

**EN.705.601** Applied Machine Learning (3 credits)

**EN.605.746** Advanced Machine Learning (3 credits)

**EN.580.491** Learning, Estimation and Control (3 credits)

**AS.050.372/672** Foundations of Neural Network Theory (3 credits)

**AS.050.371/671** Bayesian Inference (3 credits)

**Health Services Research Pathway**

***Description***

Health Services Research is the field of scientific investigation that examines how social factors, organizational structures and processes, financing systems, technologies, and behaviors affect multiple facets of health and healthcare. The goals of the Health Services Research pathway are to guide trainees in formulating an approach that is nested within economic or sociological theory, to answer research questions using a contemporary approach to causal inference, and to teach trainees skills in the analysis of cost, utilization, and value.

***Pathway-Specific Competencies***

***MHS***

* Formulate an HSR approach that is nested within economic or sociological theory
* Understand principles related to the analysis of cost, utilization, and/or value

***PhD***

* Formulate an HSR approach that is nested within economic or sociological theory
* Develop research questions using a contemporary approach to causal inference
* Acquire skills in the analysis of cost, utilization and/or value

***Pathway-Specific Courses***

***MHS***

***We recommend the following courses (but they are not required)***

**309.716** Advanced Methods in Health Services Research: Analysis (3 credits)

**221.644** Econometric Methods for Evaluation of Health Programs (4 credits)

**140.664** Causal Inference in Medicine and Public Health I (4 credits)

**140.665** Causal Inference in Medicine and Public Health II (3 credits)

**309.720** Applied Econometrics for Health Policy Research (3 credits)

***Required PhD Courses***

**309.716** Advanced Methods in Health Services Research: Analysis (3 credits)

**221.644** Econometric Methods for Evaluation of Health Programs (4 credits)

**140.664** Causal Inference in Medicine and Public Health I (4 credits)

**140.665** Causal Inference in Medicine and Public Health II (3 credits)

**309.720** Applied Econometrics for Health Policy Research (3 credits)

**301.615** Seminar in Health Disparities (3 credits)

***Electives***

**309.716** Advanced Methods in Health Services Research: Analysis (3 credits)

**221.644** Econometric Methods for Evaluation of Health Programs (4 credits)

**140.664** Causal Inference in Medicine and Public Health I (4 credits)

**140.665** Causal Inference in Medicine and Public Health II (3 credits)

**309.720** Applied Econometrics for Health Policy Research (3 credits)

**301.615** Seminar in Health Disparities (3 credits)

**300.721** Foundations in Health Policy I (2 credits)

**300.722** Foundations in Health Policy II (2 credits)

**300.723** Foundations in Health Policy III (2 credits)

**340.606** Methods for Conducting Systematic Reviews and Meta-analyses (3rd term)

**313.643** Health Economics (3 credits)

**313.644** Intermediate Health Economics (3 credits)

**410.710** Concepts in Qualitative Research for Social and Behavioral Sciences (3 credits)

**317.605** Methods in Quantitative Risk Assessment (4 credits)

**309.600** Evaluating Quality Improvement and Patient Safety Programs (3 credits)

**309.730** Patient Safety and Medical Errors (3 credits)

**300.600** Introduction to Health Policy (4 credits)

**300.651** Introduction to the U.S. Healthcare System (4 credits)

**300.721** Foundations in Health Policy I (2 credits)

**311.615** Quality of Medical Care (3 credits)

**140.656** Multilevel Statistical Models in Public Health (4 credits)

**380.712** Methods in Analysis of Large Population Surveys (3 credits)

**410.612** Sociological Perspectives on Health (3 credits)

**140.655** Analysis of Longitudinal Data (4 credits)

**340.606** Methods for Conducting Systematic Reviews and Meta-Analyses (4 credits)

**390.631** Principles of Drug Development (2 credits)

*These electives are outside of BSPH. Please contact the instructors for approval*

**BU.920.606**: Operation Management

**BU.920.607**: Competitive Strategy

**BU.920.634**: Behavioral Science: Leading Change

APPENDIX

Prerequisites for the pathway-specific courses

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Course #*** | ***Course Title*** | ***Term*** | | ***Credits*** | ***Prerequisite Course*** |
| PH.140.776 | Statistical Computing | 1 | 3 | | 140.621 Statistical Methods in Public Health I |
| PH.140.646 | Essentials of Probability and Statistical Inference I | 1 | 4 | |  |
| PH.140.647 | Essentials of Probability and Statistical Inference II | 2 | 4 | | 140.646 |
| PH.140.648 | Essentials of Probability and Statistical Inference III | 3 | 4 | | 140.646-647 |
| PH.140.649 | Essentials of Probability and Statistical Inference IV | 4 | 4 | | 140.646-648 |
| PH.140.644 | Statistical Machine Learning: Methods, Theory, and Applications | 3 | 4 | |  |
| PH.140.628 | Data Science for Public Health I | 3 | 4 | |  |
| PH.140.629 | Data Science for Public Health II | 4 | 4 | | 140.628 |
| PH.140.664 | Causal Inference | 3 & 4 | 4 | | 140.621-624 or 140.651-654 |
|  |  | Semester | Credits | |  |
| EN.520.412 | Machine Learning for Signal Processing | Fall | 3 | | AS.110.201 Linear Algebra and EN.550.310 Probability & Statistics for the Physical Sciences & Engineering and EN.520.435 Introduction to Digital Signal Processing |
| EN.520.447 | Introduction to Information Theory and Coding | Fall | 3 | | EN.553.310 Probability & Statistics for the Physical Sciences & Engineering, or EN.553.420 Probability, or EN.553.311 Intermediate Probability and Statistics |
| AS.050.371/671 | Bayesian Inference | Fall | 3 | |  |
| EN.601.475/675 | Machine Learning | Fall & Spring | 3 | |  |
| EN.601.464/664 | Artificial Intelligence | Fall & Spring | 3 | | EN.605.202 Data Structures |
| EN.605.649 | Introduction to Machine Learning | Fall & Spring | 3 | | EN.605.202 Data Structures |
| EN.705.601 | Applied Machine Learning | Fall & Spring | 3 | | EN.705.621 Introduction to Algorithms, or EN.605.621 Foundations of Algorithms, or EN.685.621 Algorithms for Data Science |
| EN.605.746 | Advanced Machine Learning | Spring | 3 | | EN.605.649 Introduction to Machine Learning |
| AS.050.372/672 | Foundations of Neural Network Theory | Spring | 3 | | AS.110.201 Linear Algebra |
| EN.580.491 | Learning, Estimation and Control | Spring | 3 | | AS.110.201 Linear Algebra and AS.110.302 Differential Equations with Applications |