BIOSTATISTICS AND BIOINFORMATICS

The Department of Biostatistics and Bioinformatics strives to improve public health through excellence in education and teaching in biostatistics and bioinformatics, transformative scientific research, and dedicated service to the university, profession and community. With Department faculty that have received more research funding than any other department at the university, the Department educates the next generation of leaders in biostatistics and bioinformatics by providing opportunities for close interactions with award winning faculty and practical real-world training opportunities in clinical trials, observational studies, diagnostic studies, and bioinformatics and computational biology studies.

UNDERGRADUATE

Undergraduate

• Minor in bioinformatics (http://bulletin.gwu.edu/public-health/biostatistics-bioinformatics/minor-bioinformatics/)

GRADUATE

Master's programs

• Master of Public Health in the field of biostatistics (http://bulletin.gwu.edu/public-health/biostatistics-bioinformatics/mph-biostatistics/)
• Master of Science in the field of biostatistics (http://bulletin.gwu.edu/public-health/biostatistics-bioinformatics/ms-biostatistics/) (Jointly administered by the Department of Statistics in CCAS and the Department of Epidemiology and Biostatistics in SPH)

Doctoral programs

• Doctor of Philosophy in the field of biostatistics (http://bulletin.gwu.edu/public-health/biostatistics-bioinformatics/phd-biostatistics/) (Jointly administered by the Department of Statistics in CCAS and the Department of Epidemiology and Biostatistics in SPH)

FACULTY

Professors  K. Crandall, S. Evans (Chair), J.M. Lachin (Research), S.J. Simmens (Research), E.A. Thom (Research)

Associate Professors    I. Bebu (Research), K.L. Drews (Research), A. Elmi, H.J. Hoffman, Y. Ma, N. Younes (Research)

Assistant Professors  A. Ciarleglio, A. Ghosh (Research), Y. Jiang (Research), M. Perez-Losada, M. Temprosa (Research), D. Uschner (Research)

COURSES

Explanation of Course Numbers

• Courses in the 1000s are primarily introductory undergraduate courses
• Those in the 2000s to 4000s are upper-division undergraduate courses that can also be taken for graduate credit with permission and additional work
• Those in the 6000s and 8000s are for master’s, doctoral, and professional-level students
• The 6000s are open to advanced undergraduate students with approval of the instructor and the dean or advising office

PUBH 3131. Epidemiology: Measuring Health and Disease. 3 Credits.
Principles of epidemiology applied to disease surveillance, control of infectious and chronic diseases, and health services/health policy. Understanding the basic research designs and their relationship to establishing cause and effect and effectiveness of interventions to prevent and cure disease. Prerequisites: PUBH 1101 and STAT 1127.

PUBH 6002. Biostatistical Applications for Public Health. 3 Credits.
Application of biostatistical principles to critical analysis of retrospective studies, prospective studies, and controlled clinical trials, as well as studies in the health services literature. Selection, basic calculations, and interpretation of statistical methods for detection of significant associations and differences.

PUBH 6003. Principles and Practices of Epidemiology. 3 Credits.
General principles, methods, and applications of epidemiology. Outbreak investigations, measures of disease frequency, standardization of disease rates, study design, measures of association, hypothesis testing, bias, effect modification, causal inference, disease screening, and surveillance. Case studies apply these concepts to a variety of infectious, acute, and chronic health conditions affecting the population.

PUBH 6235. Epidemiology of Obesity. 1 Credit.
Introduction to the epidemiology of obesity; descriptive epidemiology, measurement, consequences, and determinants of obesity; adiposity and body composition; obesity interventions and policy. Prerequisites: PUBH 6003.

PUBH 6236. Systematic Review of Public Health Literature. 1 Credit.
The process of conducting systematic reviews of literature in order to translate research into public health practice recommendations. Recommended for MPH candidates planning to conduct a systematic review of the literature for their culminating experience. Prerequisites: PUBH 6002 or EXNS 6204; and PUBH 6003 or EXNS 6208.
PUBH 6237. **Chronic Disease Epidemiology. 2 Credits.**
Overview of the epidemiology (descriptive, analytic, and etiologic) of chronic diseases. Emphasis on epidemiologic methods and study design in relation to chronic disease, as well as public health approaches to disease control including surveillance, screening, and interventions. Prerequisites: EXNS 6204 or PUBH 6002; and EXNS 6208 or PUBH 6003.

PUBH 6238. **Molecular Epidemiology. 1 Credit.**

PUBH 6239. **Epidemiology of Foodborne and Waterborne Diseases. 1 Credit.**
Foodborne and waterborne toxicants; diseases linked to eating and drinking and their prevention. Topics include transmission of disease and disease processes; microbial toxins, mycotoxins, chemical toxins, bacterial infections (e.g., salmonellosis, shigellosis, vibrio, listeria), virus and parasitic infections; issues in food and water safety. Prerequisite: PUBH 6003.

PUBH 6240. **Pediatric HIV/AIDS. 1 Credit.**
Comprehensive overview of HIV infection in children, with emphasis on the global pediatric HIV epidemic. Biological, epidemiological, clinical, and psychosocial issues; public health programmatic approaches to prevention, care, and treatment. The national and global experience with scaling up prevention services in the global effort to virtually eliminate HIV/AIDS in children. Prerequisite: PUBH 6003. Recommended background: PUBH 6250 and PUBH 6253.

PUBH 6241. **Nutritional Epidemiology. 2 Credits.**
Methodological issues related to dietary assessment, nutrition surveillance, and the epidemiology of obesity. Current trends, including the health impacts of vitamin D and sodium. Interpretation of the scientific literature in the field. Examples drawn from the National Health and Nutrition Examination Survey. Prerequisite: PUBH 6003.

PUBH 6242. **Clinical Epidemiology and Public Health: Reading the Research. 2 Credits.**
Methods for reading epidemiology and public health research including case-control, cohort studies, randomized controlled trials, meta-analysis, testing and screening, prediction rules, decision and cost-effectiveness analysis. Prerequisites: PUBH 6003 or equivalent.

PUBH 6243. **Topics in Clinical Epidemiology and Public Health: Reading the Research. 1 Credit.**
An evidence-based problem solving applications course utilizing methods taught in PUBH 6242 Clinical Epidemiology and Public Health: Reading the Research. Prerequisite: PUBH 6003.

PUBH 6244. **Cancer Epidemiology. 2 Credits.**
Epidemiology of specific cancers, with an emphasis on molecular and genetic epidemiology. Current research in the field. Prerequisites: PUBH 6003.

PUBH 6245. **Infectious Disease Epidemiology. 2 Credits.**
The role and conduct of laboratory and field investigations in the epidemiology of infectious diseases. Prerequisite: PUBH 6003.

PUBH 6247. **Design of Health Studies. 3 Credits.**
Epidemiologic concepts and methods applied to specific research questions especially new types of public health problems. Recognition and development of the most appropriate study design for a specific health issue. Ecologic, cross-sectional, case-control, cohort studies and clinical trials. Sampling, measurement, questionnaire design, causality and causal criteria. Development of a research proposal. Corequisite: PUBH 6002. Prerequisite: PUBH 6003.

PUBH 6248. **Epidemiology of Aging. 2 Credits.**
The demographics, theories, and physiology of aging; descriptive and associative epidemiology of several common age-related diseases and disorders; implications for public health. Prerequisite: PUBH 6003.

PUBH 6249. **Use of Statistical Packages: Data Management and Data Analysis. 3 Credits.**
This course familiarizes the student with one of the most widely used database management systems and statistical analysis software packages, the SAS System, operating in a Windows environment. Throughout the course, several database management system techniques and data analytical strategies for the appropriate analysis of datasets obtained from a variety of studies are presented. Statistical techniques covered include linear regression, analysis of variance, logistic regression, and survival analysis. Prerequisite: PUBH 6002.

PUBH 6250. **Epidemiology of HIV/AIDS. 2 Credits.**

PUBH 6252. **Advanced Epidemiology Methods. 3 Credits.**
Advanced quantitative epidemiologic methods, with a focus on basic data analytic techniques, identifying and evaluating bias and adjusting for confounding. Dose-response, trend analysis, and multiple linear and logistic regression models. PUBH 6249 may be taken as a corequisite. Prerequisites: PUBH 6002, PUBH 6003, PUBH 6247 and PUBH 6249.
PUBH 6253. Issues in HIV Care and Treatment. 1 Credit.
This course provides an overview and in depth consideration of some of the major issues in treatment of HIV disease, including the assessment of efficacy and effectiveness, drug resistance, monitoring of drug toxicity, special populations, the interrelationship between treatment and prevention, and quality of care. The course has been designed with an interdisciplinary audience in mind. In discussions and assignments, students are able to emphasize their own area of interest and/or expertise (e.g. epidemiology, policy, etc).

PUBH 6255. Organizational Responses to the Local, National, and Global HIV/AIDS Epidemics. 2 Credits.
This seminar focuses on the rapidly evolving responses of local, national and global governmental and non-governmental organizations to the HIV/AIDS epidemic. Inspirational leaders of selected HIV/AIDS organizations are invited to describe how their organizations contribute to fighting the epidemic; the leadership and management skills that they use in their daily work; and their strategic decision-making processes. Basic principles of epidemiology, leadership and organizational strategy and structure are addressed through didactic presentations and interactive faculty-student dialogue. Lessons learned through the lens of HIV/AIDS organizations are broadly applicable to other public health problems. Students learn about the strengths and challenges of different types of public health organizations as they make career decisions about their own transition to the public health work force. Prerequisites: PUBH 6003, HIV/AIDS experience, or permission of the instructor.

PUBH 6258. Advanced Topics in Biostatistical Consulting. 1 Credit.
Principles and practice of biostatistical consulting in public health and medical research environments.

PUBH 6259. Epidemiology Surveillance in Public Health. 2 Credits.
Focus on foundations of public health surveillance systems for communicable as well as chronic diseases. Outbreak investigation methods are included, as well as surveillance data sources, data management, data analysis, ethical issues, surveillance system evaluation, and use of information for prevention. Surveillance systems for reportable diseases, nosocomial infections, bioterrorism events, cancer, environmental disease, vaccine-related adverse events, bovine spongiform encephalopathy, and military personnel are discussed. Prerequisite: PUBH 6003.

PUBH 6260. Advanced Data Analysis for Public Health. 3 Credits.
Advanced data analysis using the SAS System to expand on the analytic techniques gained in PUBH 6002 and PUBH 6249 and to provide students with the applied statistical skills required to analyze various types of public health datasets. Prerequisites: PUBH 6002 and PUBH 6249.

PUBH 6262. Introduction to Geographic Information Systems. 1 Credit.
Geographic information systems (GIS) for mapping and display of health data. The course makes use of ArcGIS 8.3. The use of spatial statistics for the detection of clusters and patterns in the spread of diseases. Working with geodatabases, shape files, layers, query information from attribute tables, geocode addresses and customizing GIS applications.

PUBH 6263. Advanced GIS. 1 Credit.
Provides mid to advanced level training in GIS for display and analysis of health data. Use software ArcGIS 9.3 and additional extensions such as Spatial Analyst and Geostatistical Analyst. Also uses GeoDa software. Emphasizes benefits of using GIS to do more than simply manage and map data. GIS supports a range of spatial analysis functions that enable researchers to extract additional meaning from manipulating geographic data. Learn to work with raster datasets and geodatabases to build spatial models for analyzing health data and evaluating spatial patterns of health events based on notion of distance. Prerequisite: PUBH 6262.

PUBH 6264. Quantitative Methods. 3 Credits.
Introduces basic concepts in mathematical statistics. Topics include probabilities (unconditional and conditional), density and distribution functions of continuous and discrete random variables, including expected values. Specific distribution functions discussed are Binomial, Poisson, Hypergeometric, and Gaussian distributions. Additional topics include bivariate distributions, variance-covariance matrix, limiting theory, asymptotic results, and maximum likelihood estimation. Prerequisites: MATH 1231 and MATH 1232; and PUBH 6002 and 6249.

PUBH 6265. Design of Medical Studies. 3 Credits.
Design of medical investigations, including the randomized clinical trial, observational cohort study, and the retrospective case-control study. Specific methods regarding sample size, power and precision and statistical procedures for randomization and sa.

PUBH 6266. Biostatistical Methods. 3 Credits.
Biostatistical methods for asymptotically efficient tests and estimates of relative risks and odds ratios from prospective and retrospective matched and unmatched studies. Fixed and random effects models. Logistic regression, conditional logistic regression. Poisson regression. Maximum likelihood and efficient scores. Prerequisites: STAT 6201, STAT 6202 and PUBH 6264.

PUBH 6267. Time Series Applications in Public Health. 2 Credits.
Introduce basic concepts for the identification and modeling of time series in the time domain approach. Learn a new set of terminology standards and a different way to analyze these type of data and to forecast future values of a time series and its accuracy. Software used is SAS/ETS and 3 procedures: ARIMA, AUTOREG, FORECAST. New mathematical notation is used. Prerequisite: PUBH 6249.
PUBH 6268. Advanced SAS. 1 Credit.
Intensive in advanced programming using SAS. Expand technical skills to provide advanced SAS tools for data management and graphics. Topics to include Interactive Matrix Language (IML), SAS Macro facility language, and drill-down graphs using SAS/GRAPH. Prerequisites: PUBH 6002 and PUBH 6249; or permission of the instructor.

PUBH 6269. Reproductive Epidemiology. 1 Credit.
Current research, controversial issues, and methodological problems in epidemiology of reproductive and perinatal health. Present reproductive health issues such as conception and infertility; perinatal issues such as complications of pregnancy, infections in pregnancy, adverse pregnancy outcomes, and birth defects. Prerequisite: PUBH 6003.

PUBH 6270. HIV/AIDS Surveillance. 1 Credit.
Overview of surveillance methods used domestically and internationally to monitor HIV/AIDS epidemic. Surveillance systems including sentinel, population based, behavioral, and incidence surveillance are presented and discussed. Strengths and weaknesses of these various systems are discussed in addition to how data from these systems impact and inform HIV/AIDS related policies and programs. Prerequisite: PUBH 6003.

PUBH 6271. Disaster Epidemiology. 1 Credit.
Introduction to disaster epidemiology that elucidates the important role epidemiologists play in assessing the health and psychological effects of natural and man-made disasters and in identifying factors that contribute to these effects. Focus on applications of epidemiologic methods to the study of public health consequences of disasters, case studies from actual disasters used to illustrate various roles of epidemiologist in responding to these events and lessons learned. Highlight key skills that epidemiologists need to be part of a response and recovery. Identify methodological issues for future work. Prerequisites: PUBH 6002 and PUBH 6003.

PUBH 6272. Epidemiology of Infectious Agents Associated with Human Cancer. 1 Credit.
Describes the role of infectious agents in the etiology of human cancer. Emphasis on differences between specific oncogenic viruses. Other oncogenic agents, bacterial and parasitic, are also discussed. Discuss laboratory approaches to the documentation of their pathogenicity, how behavior affects mode of transmission, and which types of data provide strongest support for documenting oncogenic potential for humans. Prerequisite: PUBH 6003.

PUBH 6273. Ethnographic Methods. 1 Credit.
Use ethnographic field methods in conjunction with epidemiological research. Introduction to specific methods used to examine health phenomena and determinants of disease. Learn specific applied skills that can be modified with socio-cultural modifications to evaluate urban sites and other settings. Basic skills in application of ethnographic methods, including recursive observations, participant observations, and variety of approaches to interviewing such as in-depth, structured and non-structured as well as conversational interviewing. Discuss use of multiple approaches in conjunction with ethnography, including focus groups, archival, document, statistical and secondary data analysis, and survey research methods. Course emphasizes use of ethnographic research methods in community-based health settings and evaluates issues in cultural competency and how to garner stakeholder support to conduct epidemiologic studies. Prerequisite: PUBH 6003.

PUBH 6274. Emerging Infectious Diseases for Public Health Professionals. 2 Credits.
Focus on epidemiology of emerging infectious diseases of public health importance, including factors leading to their development, management of emerging infectious diseases from a public health and laboratory standpoint, including biosafety, and strategies for emergency preparedness from a national and international perspective. Emphasis on the context of emerging infectious diseases and strategic approaches to their containment. Prerequisites: PUBH 6003 or MICR 6292; or permission of the instructor.

PUBH 6275. Essential Public Health Laboratory Skills. 2 Credits.
This course provides public health students with practical laboratory experience. Prerequisites: MICR 6239 or permission of the instructor.

PUBH 6276. Public Health Microbiology. 3 Credits.
Gain in-depth understanding of important non-viral pathogens pertinent to public health microbiology. Learn how to isolate and identify pathogens using critical thinking and problem solving skills.

PUBH 6277. Public Health Genomics. 3 Credits.
Molecular technology and its impact on public health practice and discourse in the post-genomic era; the use of genomics to solve or help alleviate public health challenges. Prerequisites: PUBH 6002 and PUBH 6003.

PUBH 6278. Public Health Virology. 3 Credits.
In-depth understanding of viral pathogenesis by focusing on current research, controversial issues, and public health relevance. Survey of family of viruses most relevant to today’s public health efforts, concentrating on virus-host interactions and therapeutic strategies.
PUBH 6281. Analysis of Complex Surveys Using SAS and Stata. 2 Credits.
Appropriate methods to analyze survey data collected using complex sampling methods are discussed and applied to national survey data to address provocative public health research questions. An equivalent Stata course may be substituted for prerequisite 6249. Prerequisites: PUBH 6003 and PUBH 6249.

PUBH 6282. Introduction to R Programming. 1 Credit.
R is an open source software environment for statistical computing and graphics. Data transfer between SAS and R, data manipulation and visualization within R, programming and debugging, R libraries, and graphics theory. Prerequisite: PUBH 6249. Recommended background: Programming experience in a statistical package such as Stata or in high level language such as C, Python, Perl.

PUBH 6283. Biostatistics Consulting Practicum. 1 Credit.
Supervised experience involving the synthesis of biostatistical skills with client consultation. Students consolidate their skills through an experience-based understanding of how biostatistical skills are utilized in one or more domains of health research. Prerequisites: STAT 6201 and PUBH 6003. Recommended background: PUBH 6249 or PUBH 6210.

PUBH 6299. Topics in Epidemiology and Biostatistics. 1-3 Credits.
In-depth examination of a particular facet of public health. Topics and prerequisites vary.

PUBH 8242. Advanced Topics in Clinical Epidemiology and Public Health: Reading the Research. 1 Credit.
Evidence-based problem-solving approach using methods covered in PUBH 6242. Corequisite: PUBH 6242. Restricted to doctoral students. Prerequisites: PUBH 6003 or equivalent.

PUBH 8244. Doctoral Topics: Cancer Epidemiology. 1 Credit.
Course focuses on critical review and interpretation of cancer epidemiology literature as well as issues in research design in the field. Corequisite: PUBH 6244. Prerequisites: PUBH 6001 and PUBH 6003.

PUBH 8245. Doctoral Topics: Infectious Disease Epidemiology. 1 Credit.
Provides doctoral level material on the content of infectious disease epidemiology. The course focuses on critical review and interpretation of infectious disease literature as well as issues preparing an analytic research paper on an emerging infectious disease and the application of tools used to describe the epidemiology of those diseases. Corequisite: PUBH 6245. Spring Prerequisite: PUBH 6003.

PUBH 8250. Doctoral Topics: Epidemiology of HIV/AIDS. 1 Credit.
Students select specific topic within area of HIV/AIDS epidemiology. Options include responding to a data analysis problem; responding to a methodological problem found within HIV/AIDS research; or another topic approved by instructor. Corequisite: PUBH 6250. Prerequisites: PUBH 6001 and PUBH 6003.

PUBH 8259. Doctoral Topics: Epidemiologic Surveillance in Public Health. 1 Credit.
Course provides doctoral level material on the content of surveillance offered in PUBH 6259. Focus is on critical review and interpretation of surveillance literature as well as issues preparing an analytic research paper. Corequisite: PUBH 6259. Prerequisites: PUBH 6002 and PUBH 6003.

PUBH 8283. Doctoral Biostatistics Consulting Practicum. 2 Credits.
Working under supervision, students develop an experience-based understanding of how biostatistical skills are used in one or more areas of health research. Students must have completed at least 6 credits in any combination of general or specialized graduate-level statistics courses, such as PUBH 6202, PUBH 6260, STAT 6201, or STAT 6202, before enrolling in this course. Restricted to PhD students.

PUBH 8364. Quantitative Methods. 3 Credits.
Introduces basic concepts in mathematical statistics. Topics include probabilities (unconditional and conditional), density and distribution functions of continuous and discrete random variables, including expected values. Specific distribution functions discussed are Binomial, Poisson, Hypergeometric, and Gaussian distributions. Additional topics include bivariable distributions, variance-covariance matrix, limiting theory, asymptotic results, and maximum likelihood estimation. Prerequisites: MATH 1231 and MATH 1232; and PUBH 6002 and PUBH 6249.

PUBH 8366. Biostatistical Methods. 3 Credits.
Biostatistical methods for asymptotically efficient tests and estimates of relative risks and odds ratios from prospective and retrospective matched and unmatched studies. Fixed and random effects models. Logistic regression, conditional logistic regression. Poisson regression. Maximum likelihood and efficient scores. Prerequisites: STAT 6202 or permission of the instructor.

PUBH 8419. Measurement in Public Health and Health Services. 3 Credits.
Review principles of measurement and assessment as they apply to public health and health services research constructs, review existing state-of-the-art measures of individual and population health status (e.g., morbidity, mortality, functioning and health-related quality of life) and of individual and community health behavior. Explore current measurement issues in health research.

PUBH 8999. Dissertation Research. 1-12 Credits.
Dissertation research.