

Institute for Informatics (I²)

Applied Clinical Informatics & Data Analytics Workshop

Workshop Description: This workshop will introduce participants to the foundational theories and methods needed to design, deploy, and manage clinical information systems, as well as extract and analyze the data produced by such platforms. This workshop is designed for participants without formal training in the computational science and biomedical informatics domains, but who are familiar with either healthcare research or operations, such as clinicians, administrators, and technologists.

This workshop will be team-taught by faculty affiliated with the Washington University School of Medicine's Institute for Informatics (I²) and the Universidad de Desarrollo's Clínica Alemana.

Core concepts to be reviewed during this course include:

- types of clinical information systems and the architecture of integrated information management platforms for use in the clinical setting,
- factors that influence clinical information system adoption and usability,
- use of data models and standard terminologies and ontologies,
- data reporting and warehousing,
- evaluating data quality and completeness,
- statistical summarization of clinical data,
- use of machine learning to identify patterns in complex biomedical data, and
- visualization of analytical results,

The Washington University School of Medicine (WUSM) is a world class scientific environment that provides unique strengths and efficiencies across a full spectrum of research, education, and patient care activities. Since its founding in 1891, WUSM has trained nearly 9,000 physicians and has contributed groundbreaking discoveries in many areas of medical research. WUSM is internationally known for research in neuroscience, genetics, diabetes, cardiovascular diseases, oncology, immunology, diagnostic imaging, and many other specialty areas. In 2017, WUSM was ranked #7 by U.S. News & World Report among the nation's research-oriented medical schools, and #4 in terms of total National Institutes of Health funding.

The Institute for Informatics (I²) provides an academic and professional home for informatics science and practice at Washington University, spanning WUSM as well as partnerships with the School of Engineering and Applied Science, the Institute for Public Health, the Brown School, the Olin School of Business, the Innovations Incubator at BJC HealthCare, and the Cortex Innovation Community. I² engages in innovative research, workforce development, and informatics service delivery targeting a variety of critical areas of need, including:

- the integration and dissemination of heterogeneous data, information, and knowledge resources;
- computational approaches to the interpretation of bio-molecular, image, and clinical phenotypes to inform precision medicine;
- the acceleration of clinical and translational research through the systematic management of study protocols, data resources, and analytical pipelines;

- the creation of learning healthcare systems in which cyclical evidence generation and application becomes integral to care delivery;
- the use of ubiquitous computing and sensing technologies capable of facilitating population health monitoring and intervention strategies; and
- methodological and technical approaches to enable and enhance research reproducibility and rigor.

UDD's Medical School was ranked second in Chile in the national medical exam, surpassing most traditional universities in Chile. UDD is currently ranked as the best private university in Chile, standing 5th overall, according to the national CNAP accreditation program.

WUSM & UDD Faculty

Mario Barbé, MD, MS

Chief, Unit of Data Analysis and Artificial Intelligence

Department of Biomedical Informatics, Clínica Alemana de Santiago



Dr. Barbé's recent research has focused on the application of machine learning techniques to solve clinical problems in oncology, radiotherapy, and neurology. Dr. Barbé received his Master of Science in Health Informatics and Analytics from The University of North Carolina at Charlotte. He focused on developing of a model that was able to predict the radiation received during the radiation therapy by the organ at risk in patients with prostate cancer. Dr. Barbé also received his Medicine Doctor degree from Pontificia Universidad Católica de Chile.

Randi Foraker, PhD, MA

Associate Professor, Department of Medicine, Division of General Medical Sciences

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Dr. Foraker is the director of the Center for Population Health Informatics (CPHI) in the Institute for Informatics and an associate professor in General Medical Sciences at Washington University School of Medicine in St. Louis. Dr. Foraker also serves as faculty director for the Data Management and Training Center for the Institute for Public Health. Dr. Foraker specializes in the design of population-based studies and the integration of electronic health record data with socioeconomic indicators and is well-recognized in the field of cardiovascular disease epidemiology. Her recent research has focused on the application of clinical decision support to complement risk scoring in primary care, cardiology, and oncology. Her research portfolio has been supported by a combination of governmental and industry grants and contracts. Previously, Dr. Foraker served as an associate professor of Epidemiology at The Ohio State University College of Public Health.

Dr. Foraker received her PhD in epidemiology from The University of North Carolina at Chapel Hill, where her research focused on evaluating the impact of socioeconomic status on incident cardiovascular disease, receipt of cardiovascular treatments, and the progression of heart failure. Dr. Foraker also received her undergraduate and graduate degrees in education and health promotion, respectively, from The University of Iowa.

Albert M. Lai, PhD

Deputy Director, Institute for Informatics (I²)

Chief Research Information Officer, School of Medicine

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Dr. Lai is the deputy director for the Institute for Informatics and an associate professor of General Medical Sciences. Dr. Lai also serves as the inaugural chief research information officer (CRIO) at Washington University School of Medicine in St. Louis. Dr. Lai specializes in the development of research informatics infrastructure and is well recognized in the fields of clinical research informatics and consumer health informatics. His recent research has focused on the application of natural language processing, temporal reasoning and information fusion to generate a longitudinal computable phenotype to support clinical trial prescreening. His research portfolio has been supported by a combination of NCATS, NLM, NCI, AHRQ and PCORI grants and contracts. Previously, Dr. Lai served as the associate chief research information officer at The Ohio State University Wexner Medical Center.

Marcelo A. Lopetegui Lazo, MD, MS (Co-Chair)

Director of the Center for Innovation and Research in Biomedical Informatics

Department of Biomedical Informatics, Clínica Alemana de Santiago



Dr. Lopetegui is the Medical Director of Clinical Informatics Services at "Clínica Alemana de Santiago", Chile. He was recently appointed inaugural director for the Center of Biomedical Informatics at Universidad del Desarrollo, where he leads research and innovation focused projects. He established the first clinical informatics internship for medical students in Chile, and recently founded the first clinical informatics fellowship for physicians. He also serves as the vice president of the Chilean Health Informatics Association (ACHISA). Dr. Lopetegui is a recognized pioneer

in the field of Health Informatics in Chile, founding and organizing the Chilean Health Informatics Annual Symposium and collaborating in both government and industry-initiated efforts to establish the discipline locally.

Maurizio Mattoli

Coordinador

Centro de Informática Biomédica

Instituto de Ciencias e Innovación en Medicina (ICIM)

Facultad de Medicina Clínica Alemana-Universidad del Desarrollo



Maurizio Mattoli is the coordinator for the Biomedical Informatics Center of the Institute of Science and Innovation in Medicine (ICIM) at Universidad del Desarrollo. His main areas of interest are software development project management in healthcare, telemedicine applications, and information security management. He participated into several telemedicine services implementations in Chile, ranging from the nation-wide tele-electrocardiography service for the Acute Myocardial Infarction Protocol (Plan Auge - Chile), to the provision of an e-consultation platform for the Galileo Telemedicine Program (Hospital Las Higueras, Servicio de Salud Talcahuano). He was previously

assistant manager for the Medical Informatics and Telemedicine Center (CIMT) and for the Telemedicine Project at the Hospital Clínico de la Universidad de Chile (HCUCH) and also served as president of the Chilean Association of Health Informatics (2011-2013).

Philip R.O. Payne, PhD, FACMI (Co-Chair)

Robert J. Terry Professor and Director, Institute for Informatics
Professor, Department of Medicine, Division of General Medical Sciences
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Dr. Payne is the founding director of the Institute for Informatics (I²) at Washington University in St. Louis, where he also serves as the Robert J. Terry Professor and Professor of Computer Science and Engineering. Previously, Dr. Payne was professor and chair of the Department of Biomedical Informatics at The Ohio State University.

Dr. Payne is an internationally recognized leader in the field of clinical research informatics (CRI) and translational bioinformatics (TBI). His research portfolio is supported actively by a combination of NCATS, NLM, and NCI grants and contracts, as well as a variety of awards from both nonprofit and philanthropic organizations. Dr. Payne received his Ph.D. with distinction in biomedical informatics from Columbia University, where his research focused on the use of knowledge engineering and human-computer interaction design principles in order to improve the efficiency of multi-site clinical and translational research programs. Prior to pursuing his graduate training, Dr. Payne served in a number of technical and leadership roles at both the UCSD Shiley Eye Center and UCSD Moores Cancer Center.

Dr. Payne's leadership in the clinical research informatics community has been recognized through his appointment to numerous national steering, scientific, editorial, and advisory committees, including efforts associated with the American Medical Informatics Association (AMIA), AcademyHealth, the Association for Computing Machinery (ACM), the National Cancer Institute (NCI), the National Library of Medicine (NLM) and the CTSA consortium, as well as his engagement as a consultant to academic health centers throughout the United States and the Institute of Medicine. His research interests include: 1) knowledge-based approaches to the discovery and analysis of bio-molecular and clinical phenotypes and the ensuing identification of precision diagnostic and therapeutic strategies in cancer; 2) interventional approaches to the use of electronic health records in order to address modifiable risk factors for disease and enable patient-centered decision making; and 3) the study of human factors and workflow issues surrounding the optimal use of healthcare information technology.

Academic and program management support for this workshop is provided by:



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Workshop Format: The format of this workshop includes a combination of: 1) didactic lectures, 2) case studies, and 3) hands-on laboratory exercises taught over a three-day period. Most lectures will be in English.

Prerequisites: Participants in this workshop are not required to have any prior experience in or knowledge of biomedical informatics. Participants should be familiar with:

- Fundamentals of healthcare research and/or delivery
- Common biomedical terminology
- Basic computational skills

Preferred prerequisite knowledge includes familiarity with basic statistics and/or probability, although these principles will be covered briefly during the workshop.

Learning Objectives: By the end of the workshop, participants will be able to demonstrate understanding and/or mastery of the following major areas:

- The definition of biomedical informatics (BMI) and its major sub-disciplines
- Critical areas of BMI research and practice
- Mechanisms for accessing the BMI knowledge base
- Types of clinical information systems, their use, and how systems-level architectures consisting of multiple technologies can be created to provide an information management platform for healthcare research and delivery
- Human-computer interaction design principles and the evaluation of technology adoption and usability
- Common data models, APIs, terminologies, and ontologies that can be used to support semantic interoperability between clinical information systems
- Data warehouse and reporting system design and operation
- Quantitative and qualitative measurements of data completeness and quality
- Descriptive statistics and their use in summarizing clinical data
- Machine learning methods that can be applied to complex biomedical data
- Methods for visualizing the result of both statistical summaries and deeper analyses of complex biomedical data

Readings: The readings for this workshop are drawn primarily from the PLOS Computational Biology Education Collection (<http://collections.plos.org/compbiol-education>) as well as contemporary articles

selected by the faculty. Specific reading assignments will be provided to registered participants in advance of the workshop.

Other Requirements: Participants should have a laptop computer available for use during the workshop. They should have sufficient access privileges to download and install open source data analysis packages such as Jupyter Notebook (<http://jupyter.org/>) and Weka (<https://www.cs.waikato.ac.nz/ml/weka/>).

Please note: All course software must be downloaded 24 hours in advance of first session.

Grading: Participants will not be graded during the workshop, but personalized feedback on hands-on learning exercises will be provided by the faculty.

Course certificate: All participants will receive a certificate of completion signed by Co-Chairs Drs. Philip R.O. Payne and Marcelo A. Lopetegui Lazo.

Course Schedule (see attached):