Pre-Conference Session

Creating Meaning out of Chaos: Linking Big Data Tools to Pathophysiology, Biomarkers, Diagnoses and Clinical Studies

Common Features Session Co-Chairs:

Beau Ances, Diane Bovenkamp, Adriana Di Polo, Joanna Jankowsky, Rebecca Sappington, Florian Sennlaub, Malu Tansey

Additional Common Features Committee Members:

Catherine Bowes Rickman, Guojun Bu, Todd Golde, Sharyn Rossi, Preeti Subramanian, Cheryl Wellington

Symposium Summary:

This day-long, CME credit-eligible workshop will provide participants with an understanding of the common and distinct features of neurological and ocular degenerative disease. This session will address how to use analytic and computational tools to wrangle large datasets, spot patterns that may not be inherently obvious, and sort through thousands, if not millions, of health records to find and recruit eligible participants with health equity and population representation in mind.

This fifth pre-conference workshop will begin with a look at using big data to discover how disease begins and advances (Section 1. Mechanistic Insight from Multi-Omics and Imaging), then progress to probing increased or decreased risks in individuals or populations, as well as developing precision diagnoses (Section 2. Big Data in Biomarker Discovery and Diagnoses), and end with a more holistic point of view of clinical studies (Section 3. Big Data in Clinical Studies). Some questions that will be addressed:

Questions to consider:

- What is ‘big data’?

- Do I have to be an expert at ‘big data’ to use it in my research?
- What are some open access (or easily accessible) ‘big data’ resources for researchers- especially with regards to neurological and ocular degenerative diseases?
- How does the multi-etiology nature of dementia and other neurodegenerative diseases complicate biomarker development and diagnoses?
- How can I use ‘big data’ to design clinical studies that represent the general population and ensure health equity should a treatment make it to the market?
- How can I use ‘big data’ to determine differences between sexes, racial/ethnic groups, and potential environmental or socio-economic differences between populations?
- Are there common origins and/or elements across brain and eye neurodegenerative diseases that could give us a clue to future risk reductions, better and earlier detection of disease, and disease-modifying treatments?

8:00-8:10 CET | Welcome and Introductions

- Diane Bovenkamp, BrightFocus Foundation (USA)

8:10-9:50 CET | Session 1: Mechanistic Insight from Multi-Omics and Imaging

9:50-10:05 CET | Break/Snack

10:05-11:50 CET | Session 2: Big Data in Biomarker Discovery and Diagnoses

11:50-12:50 CET | Break/Lunch (provided)

12:50-14:55 CET | Session 3: Big Data in Clinical

Studies

14:55-15:15 CET | General Discussion and Closing Remarks

Please find more details about the sessions below:

8:10-9:50 CET | Session 1: Mechanistic Insight from Multi-Omics and Imaging

- Moderator 1: Joanna Jankowsky, Baylor College of Medicine (USA)
- Moderator 2: Florian Sennlaub, Institute de la Vision de France (France)

Summary:

Experimental science is inherently reductive, while the diseases we seek to understand are complex, multifaceted, and complicated by comorbidities. Advances in multi-omic, high-throughput, and quantitative tissue analysis offer a new and unbiased view of disease states that have broadened our understanding of pathogenesis. The speakers will discuss their use of high resolution 'omics' to uncover the intricate cellular and synaptic processes leading to neurodegeneration within the brain and retina. They will delve into the integration of data across various scales to identify potential pathways associated with central nervous system and ocular diseases. Participants will learn how a range of advanced 'omics and imaging technology to capture and condense data at scale can be leveraged for mechanistic discovery.

- **8:10-8:15 CET |** Joanna Jankowsky, USA Florian Sennlaub, France, *Session 1: Mechanistic Insight from Multi-Omics and Imaging Moderated Introduction*
- **8:15-8:35 CET |** Li-Huei Tsai, Massachusetts Institute of Technology (USA), *Single cell dissection of dementia pathogenesis*
- **8:35-8:55 CET |** Junmin Peng, St. Jude's Children's Research Hospital (USA), *Cross-species proteomics of dementia: of mice and men*
- **8:55-9:15 CET |** Deborah Ferrington, Doheny Eye Institute (USA), *Proteomic characterization of the retinal pigment epithelium in aging and degeneration*

- **9:15-9:35 CET** | Vinit B. Mahajan, Stanford University (USA),
  Liquid-biopsy proteomics combined with AI identifies cellular drivers of eye aging and disease in vivo
- **9:35-9:50 CET |** Panel Discussion

10:10-11:50 CET | Session 2: Big Data in Biomarker Discovery and Diagnoses

- Moderator 1: Malu Tansey, University of Florida, Gainesville (USA)
- Moderator 2: Adriana Di Polo, Université de Montréal, Quebec (Canada)

Summary:

Biomarkers are an important component in biomedical research and in the clinical setting they can have diagnostic, staging, and prognostic value. Ideally, the field is seeking to validate fluid, imaging, and digital biomarkers that will help identify individuals at risk for certain diseases, stratify them for clinical trials, monitor/assess responsiveness to interventions or treatments. The speakers will discuss various biomarker strategies and modalities currently in use or emerging in the field of neurodegeneration within the brain and retina. Participants will learn how a range of biomarkers could be used alone or in combination to assess potential participants for risk, stage, and progression of disease.

- **10:05-10:10 CET |** Malu Tansey, USA Adriana Di Polo, Canada | *Session 2: Big Data in Biomarker Discovery and Diagnoses Moderated Introduction*
- **10:10-10:30 CET |** Jaime Hatcher-Martin, *Synapticure (USA)*
  Digital biomarkers in Neurodegeneration
- **10:30-10:50 CET | Thomas K. Karikari,** University of Pittsburgh (USA), *Multi-analyte biomarker panels for distinguishing between neurodegenerative diseases*
- **10:50-11:10 CET** | Keith Hengen, Washington University at St. Louis (USA),
  Emergent dynamics are signature of the function of sleep and a predictive biomarker of neurodegenerative disease
- **11:10-11:30 CET** | Cecilia Lee, University of Washington (USA),
  Big data applications in ophthalmology and Alzheimer's disease

- **11:30-11:50 CET |** Panel Discussion

12:50-14:50 CET | Session 3: Big Data in Clinical Studies

- Moderator 1: Beau Ances, Washington University in St. Louis (USA)
- Moderator 2: Rebecca Sappington, Wake Forest (USA)

Summary:

Large investments and more recent technological advances in data collection has led to extensive longitudinal information on thousands of patients with neurological and ocular degenerative diseases. These "big data" databases can potentially advance our understanding of these diseases and lead to novel drug development. These advances need to be linked with analytical methods that go beyond retrospective data-driven associations with various clinical phenotypes. Novel associations derived from machine learning algorithms can help generate potential hypotheses, but need to be linked with an understanding of the pathology so that actionable drug discovery and development continues to occur. Mechanism-based modeling needs to be combined with data-driven analytics in clinical big datasets to generate new information for drug discovery programs, target validation, and optimization of clinical development.

- **12:50-12:55 CET |** Beau Ances; Rebecca Sappington, USA **|** *Session 3: Big Data in Clinical Studies Moderated Introduction*
- **12:55-13:15 CET |** Michelle Mielke (USA), *Sex-based differences and applications of blood based biomarkers to large populations*
- **13:15-13:35 CET |** Gareth Howell, Jackson Laboratories (USA), *Multi-omic approaches to uncover disease models for neurodegenerative diseases of the eye and brain*
- **13:35-13:55 CET** | Michael Chiang, National Eye Institute (USA) *A roadmap to interoperable ophthalmic imaging standards in the united states*
- **13:55-14:15 CET** | Gustavo Jimenez-Maggiora, University of Southern California (USA), *Applications of big data analyses to clinical trials in Alzheimer disease*
- **14:15-14:35 CET |** Rhoda Au, Boston University (USA), *Applications of*

Large Digital Technology Datasets for Aging and Dementia Research: What the Framingham Study Has Taught Us

- **14:35-14:55 CET |** Panel Discussion