Data Fusion and Statistical Learning in Patient Care Cycle: From Diagnosis to Care to System-Level Decision-Making

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Technology advancements in diagnostic imaging, smart sensing, and health information systems have resulted in a Big Data environment in health care. It is not possible to track every piece of information related to a patient’s care cycle including diagnosis, prognosis, treatment, care delivery, and continuous monitoring. This offers a great opportunity for Precise Medicine. On the other hand, the size and complexity of the data overwhelm the modeling capability of existing statistical methods. In this talk, I will present two topics that tackle the data science challenges in migraine diagnosis/subtyping and in care coordination, respectively. In the first topic, a Multimodality Factor Mixture Model (MFMM) is developed to enable migraine subtype discovery from multimodality imaging data. MFMM employs a novel doubly-penalized formulation to achieve hierarchical selection of informative imaging modalities and informative features within each modality. This work enables refined classification of migraine patients and subtype-optimized treatment. In the second topic, I will present the development of a Multi-response, Multi-level Model (M3) to fuse multi-source data collected by the recently developed Nurse Care Coordination Instrument (NCCI), in order to reveal how care coordination activities are affected by nurse training, workload, and their practice environment. This work enables development of best practices to improve care coordination and patient outcomes.