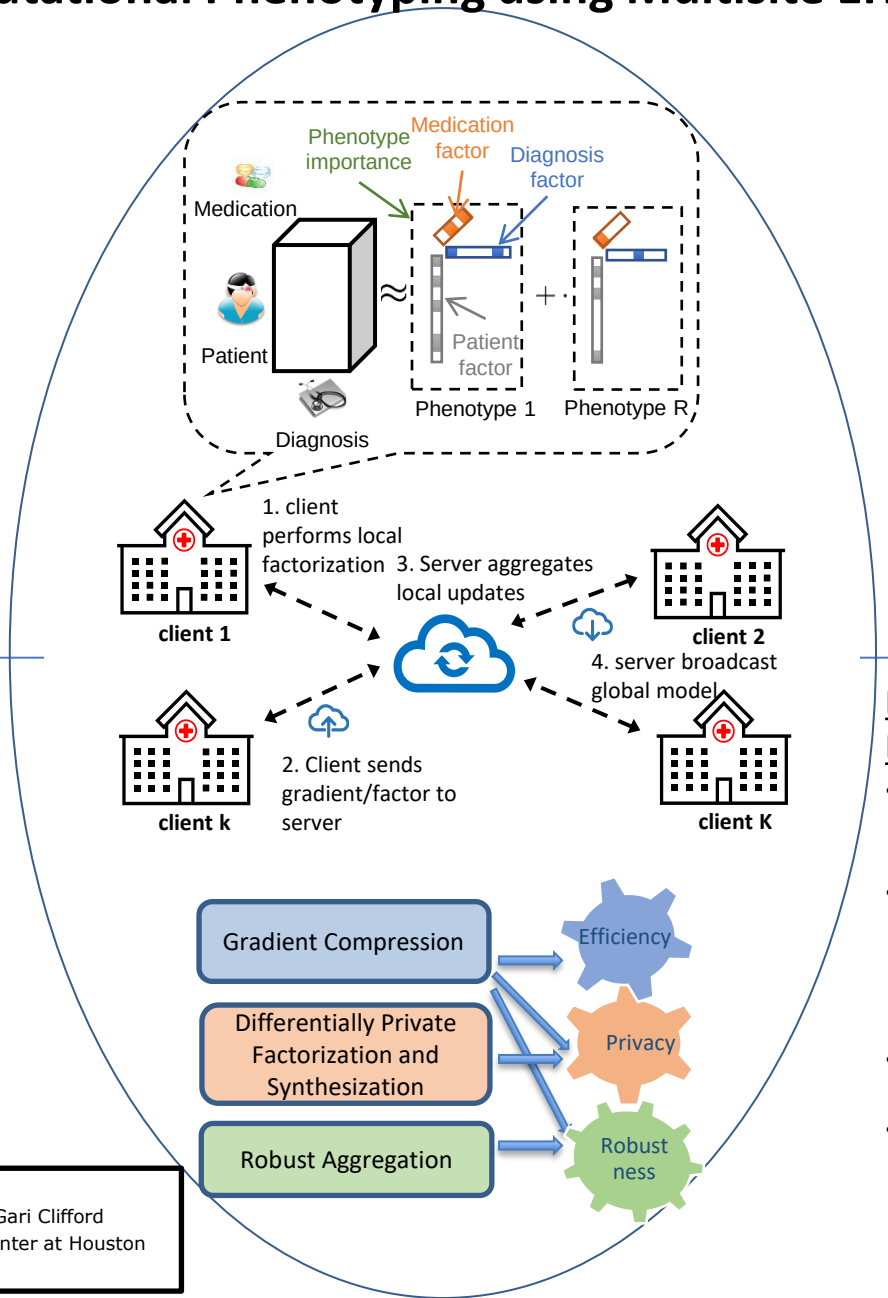
PREMED: Privacy-Preserving and Robust Computational Phenotyping using Multisite EHR Data

Challenge:

- Tensor factorization (e.g., for Computational phenotyping) across multiple institutions without trusted third party while preserving individual privacy
- Multi-factor decomposition structure
- Interrelated challenges of communication efficiency, privacy risk of intermediate communication between clients and server, and robustness against potential Byzantine failures and malicious sites

Solution:

- Communication-efficient techniques such as gradient compression utilizing the multi-level structure
- Privacy-preserving techniques via differentially private factorization utilizing privacy benefit of compressed gradients and data synthesization while preserving latent factors (phenotypes)
- Robust aggregation techniques via robust statistics and truth inference utilizing robustness benefit of compressed gradients



Scientific Impact:

- Federated tensor factorization framework ensures formal privacy and robustness guarantee.
- Applicable to variety of application such as computational phenotyping and recommender systems
- Exploiting synergy among efficiency, privacy, and robustness enhances the tradeoff with accuracy thanks to the implicit privacy and robustness benefit of communication efficient techniques (e.g., quantized gradients reveal less information and has less adversarial impact on the global model/factors)

Broader Impact and Broader Participation:

- Allow institutions to jointly perform computational phenotyping using privacy-protected data
- Case studies using real EHR data from Emory and UTHealth for phenotype discovery and phenotype-based predictive studies for Alzheimer's Disease and Sepsis.
- Prototype development and dissemination
- Development of collaborative sidecar courses and involvement of undergraduates, women and underrepresented groups

#2124104 Emory University
Li Xiong, Sivasubramanium Bhavani, Joyce Ho, Gari Clifford
#2124789 University of Texas Health Science Center at Houston
Xiaoqian Jiang, Paul Schulz