





#### ModelChain: Decentralized Privacy-Preserving Healthcare Predictive Modeling Framework on Private Blockchain Networks

Tsung-Ting Kuo, Chun-Nan Hsu, and Lucila Ohno-Machado pSCANNER Face-to-Face Meeting

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Winning Submissions

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### **Predictive Modeling**

- Healthcare predictive modeling
  - > Machine learning from healthcare data to predict outcomes
- Cross-institutional healthcare predictive modeling
  - > More generalizable models
  - > Comparative effectiveness research, biomedical discovery, patient-care, etc.
  - > Especially for large research network like pSCANNER



pSCAN

### Protecting Privacy of Individuals

- Challenge of cross-institutional predictive modeling
  - > Improper disclosure of protected heath information (PHI)
- Privacy-preserving algorithms transfer models but not PHI
  - > Many methods exist [Wu et al. 2012] [Li et al. 2015] [Wang et al. 2013] [Yan et al. 2013]



### **Risk for Existing Algorithms**

- Centralized architecture
  - > Institutional policies
  - > Single-point-of-failure/breach
  - > Sites cannot join/leave at any time
  - Mutable data and records
  - Consensus/synchronization issues



### The Blockchain Technology

- Desirable features
  - Decentralized architecture
    - » Peer-to-peer
    - » Sites keep full control of resources
    - » No risk of single-point-of-failure
  - Sites can join/leave freely
    - » No central server overhead
    - » No disruption of learning process
  - Immutable audit trail
    - » Tampering is difficult









### ModelChain

- 1. Privacy-preserving online machine learning on blockchains
- 2. Transaction metadata to transfer partial models and info
- 3. Proof-of-information algorithm to decide order of learning





- Blockchain infrastructure as in Bitcoin
- ModelChain: distributed predictive models across institutes
- Privacy protection by exchange of model, not patient data
- No single-point-of-failure
- Verified data provenance
- Secure record of transactions
- Improved interoperability
- White paper and full slides: <u>https://healthit.gov/blockchain</u>

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Tsung-Ting Kuo PhD



Chun-Nan Hsu I PhD



su Lucila Ohno-Machado MD, PhD



Xiaoqian Jiang PhD



Shuang Wang PhD

# Thank you!

## Questions?



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