Open Algorithm (OPAL) :: Privacy-Preserved Blockchain-Based Medical Solutions

:: Principles
1. Encrypted Data
2. Vetted Algorithms
3. Algorithm mobility to local data
4. Decentralized Algorithm Executions
5. Distributed Repositories
6. “Safe Answers”

:: Clinical Trials
OPEN TrialChain (annykim@mit.edu)

:: Urgent Care
SMART^2 OPAL (shada@mit.edu)

:: Clinical Intervention
RoboChain (ecstll@media.mit.edu)

**OPEN TrialChain** balances between the sharing of clinical data and the need for subject’s privacy protection by allowing queries on decentralized raw datasets from which it returns aggregated safe answers that are blinded (i.e. anonymized).

**Benefits**
1. Encourages pharmaceutical companies to report their trial results with higher fidelity, as well as, federated ones to provide more detailed results in return for their peers’ detailed results.
2. Allows for multiple studies to be queried for results from underrepresented demographics, producing greater insight from previously ignored minorities.
3. Illustrates meaningful results without violating the privacy of individuals.

**SMART^2 OPAL** helps decision makers optimize urgent care system in Saudi Arabia by understanding the dynamics of time between symptom to arrival to emergency department using timestamps without revealing the identity of the centers, and making informed decisions.

**Today 45% of Saudi Arabian population suffers from cardiovascular diseases.** Time to treatment should be < 30 min for heart attack patients & < 3.5 Hours for stroke attack patients. However, ambulance diversion is killing patients in Saudi Arabia, resulting in 84% of those patients avoiding ambulances when having an attack.

**RoboChain** is the first learning framework for secure, decentralized and computationally efficient data and model sharing among multiple robot units installed at multiple sites (e.g., hospitals). It builds upon and combines the latest advances in open data access and blockchain technologies, as well as machine learning.

**System architecture and data flow.** The proposed system involves three main sections where (A) safe data is retrieved from protected databases using the OPAL paradigm, (B) the pairs of queries/answers are stored in the blockchain for accountability and transparency reasons, (C) the data derived from the therapy is used as an input to train and share ML models. All the procedures within the black rectangles are carried out in a local fashion (i.e., at the robots’ own hardware).

**Robots have potential to revolutionize clinical interventions if they can access to private data in order to enhance their learning process, and share knowledge among multiple robot units.**