Blinded Record Index:
How Fancy Math Will Help Us Get Better Outcome Data

MPOG
MULTICENTER PERIOPERATIVE
OUTCOMES GROUP

The need

- Link data sources to get better outcome data
  - Currently available
    - Electronic health record, anesthesia record, ACS-NSQIP, STS locally using MRN
    - Michigan value collaborative payer data using date of service, age, hospital
  - Allow persistence of linkage for future datasets
    - State-specific mortality databases
    - BCBS of Michigan
    - Medicare, other payers
    - Pharmacy databases
  - Ensure no single point of security or privacy failure

A wise man once told me

- “When you have two choices, the one that is more work for you is almost always the right one” – Mike Englesbe
  - Applies to clinical decisions
  - Also applies to privacy and security

- We must NOT communicate or store real identifiers at the MPOG central server, even if the IRB allows us to do so
  - Do you want your family’s SSN sitting at the coordinating center?

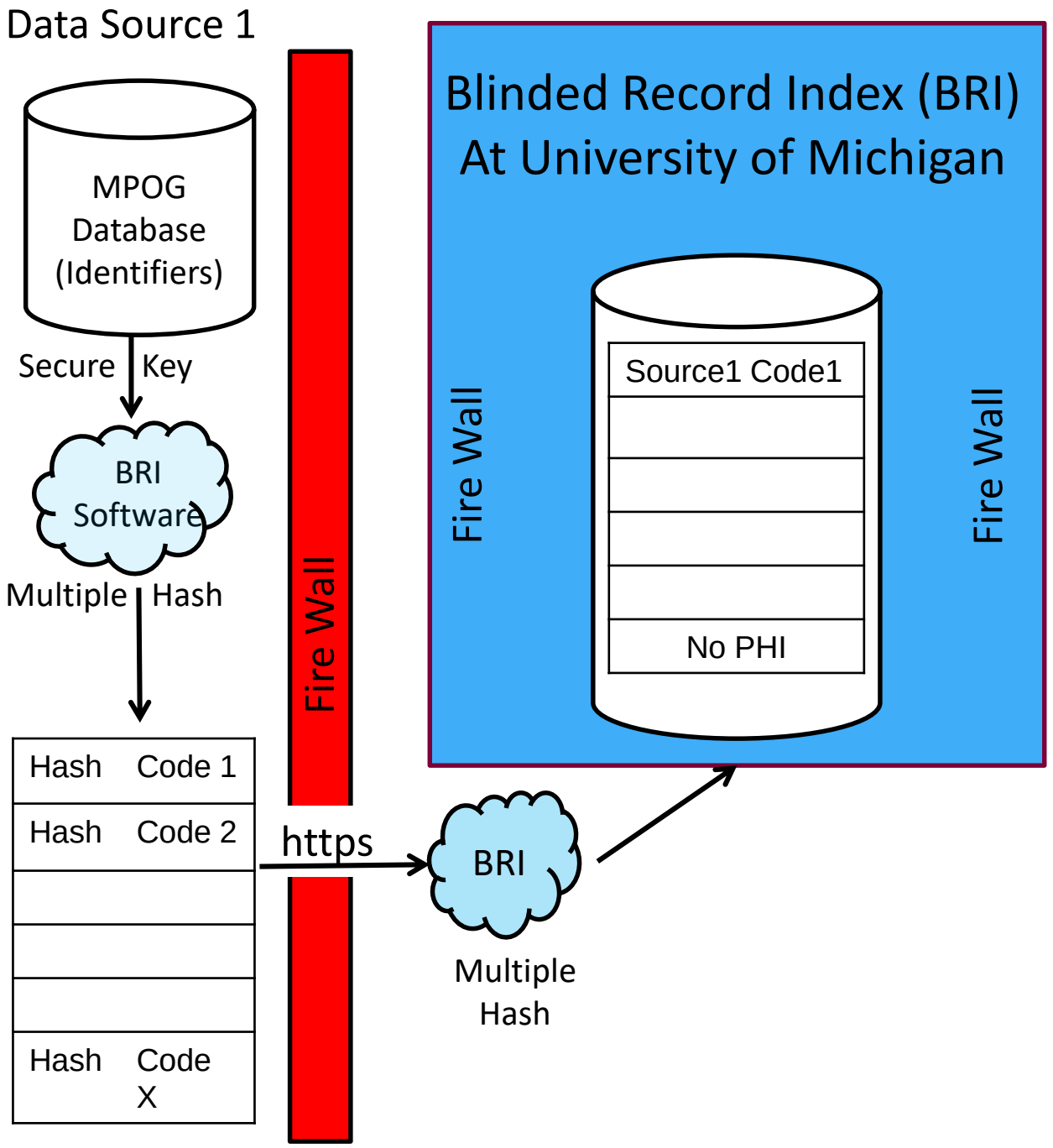
The solution

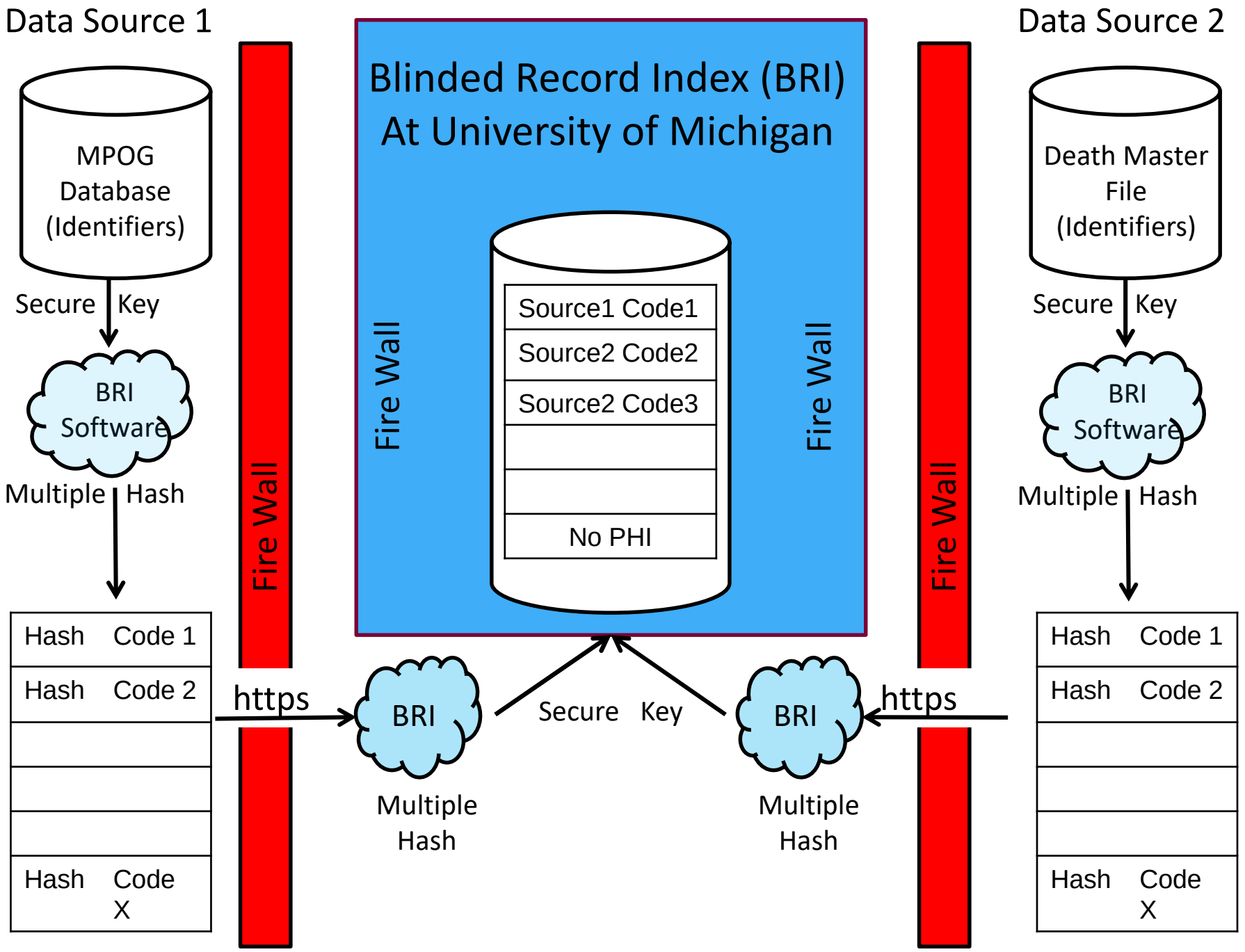
- Blinded record linking
  - For merging datasets across sites without PHI
  - Using US National Institutes of Standards and Technology Secure Hashing Algorithm
  - Incorporate RSA secure key
  - Keep the hashed codes centrally, no source identifiers
  - Hashed codes can be linked across data sources
- Established
  - Public domain hashing algorithm
  - “blessed” by federal government in registries manual as non-PHI
  - Approved by IRBs, DUA at all MPOG institutions
  - Ready for rollout across MPOG

What is hashing

- Publicly available one-way mathematical function
  - Input: a string (identifier)
  - Output: a really long alphanumeric code
- Cannot be “undone”
  - It is NOT encryption (which is meant to be decrypted)
- There are no “collisions”
  - No two strings result in the same hash code
  - Source uniqueness is maintained
  - Small changes in input string result in large changes in output code
- Example: Sachin →

964FA766292D50C62019ED7D33232559C0AF511CDDD5E55938AA845698F771B9


Data Source 1
MPOG Database (Identifiers)
Secure Key
BRI Software
Multiple Hash
Hash Code 1
Hash Code 2
Hash Code X
Fire Wall
https
BRI
Multiple Hash
Blinded Record Index (BRI) At University of Michigan
Fire Wall
Source1 Code1
No PHI
Fire Wall


Data Source 1
MPOG Database (Identifiers)
Secure Key
BRI Software
Multiple Hash
Hash Code 1
Hash Code 2
Hash Code X
Fire Wall
https
BRI
Multiple Hash
Blinded Record Index (BRI)
At University of Michigan
Fire Wall
Source1 Code1
Source2 Code2
Source2 Code3
No PHI
Secure Key
Fire Wall
BRI
Multiple Hash
https
Data Source 2
Death Master File (Identifiers)
Secure Key
BRI Software
Multiple Hash
Hash Code 1
Hash Code 2
Hash Code X

Example: Mortality Ascertainment

- Using social security death master file (DMF) (No longer available)
  - Treated DMF as a ‘data source”
  - Hashed each patient record in DMF since 2003
  - Kept date of death as plain text
    - Date of death is publicly available
    - Need to keep unhashed for research purposes
- Each MPOG site’s patient records are also hashed
- Centralized Blinded Record Index (BRI)
  - Match clinical patient records against DMF patient records
  - Apply “last known alive” check step to improve specificity

Study goals

- Establish that blinded record linking was
  - Feasible (computationally)
  - Economical (server quality / speed)
  - Accurate: acceptable match rates
- Evaluate the impact of
  - Varying ‘stringency’ levels on matching algorithm
    - Exact match of all (SSN, DOB, name)
    - Exact match of one and close match of others
    - Somewhere in between
  - Value of “last known alive date” to improve specificity
  - Value of SSN

Methods

- 2400 patients across 2 distinct sites
  - University of Michigan
    - Suburban / rural patient population
    - 90% SSN fill rate
  - Thomas Jefferson University
    - Urban / metropolis patient population
    - 70% SSN fill rate
- Established “gold standard” dead and alive status
  - Manual review of patient records
  - Prospective patient registry
  - 30 day and 1 year mortality

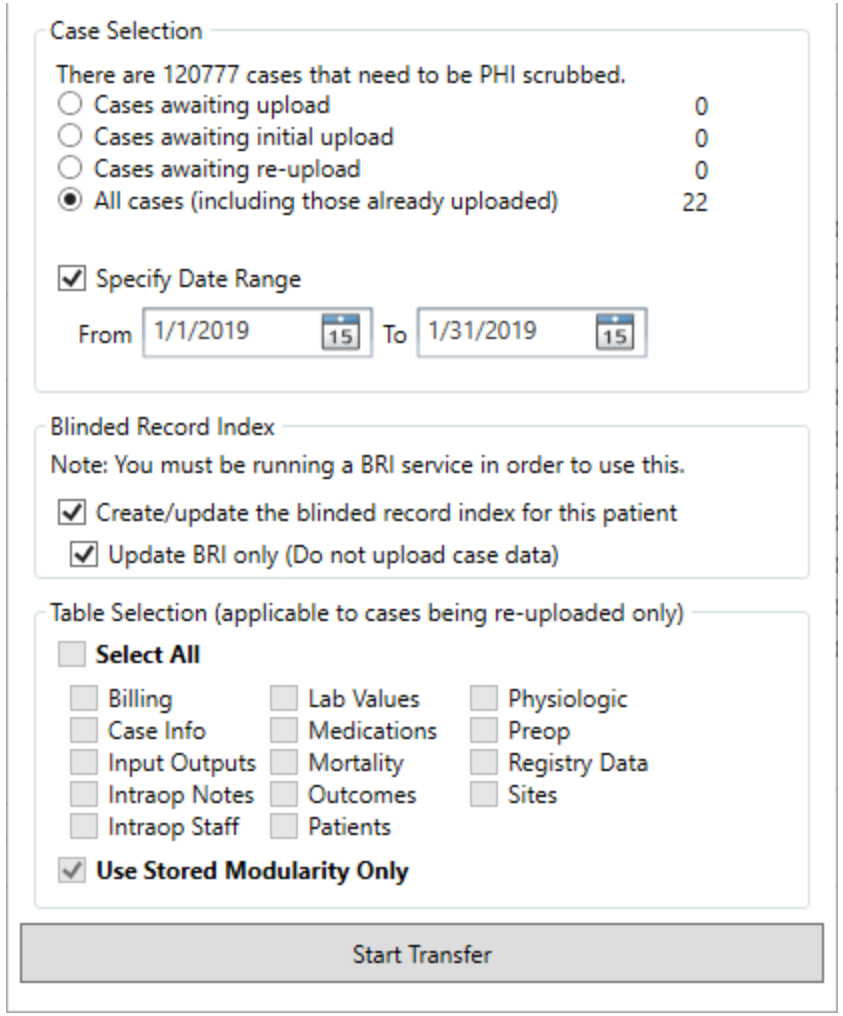
Results

- Achievable
  - IRB approved each center's work
  - Standard commercially available servers
  - Commercially available software from 3rd party vendors
- 30 day mortality
  - Very Strict matching: Sens: 89.7% Spec:100%
  - Expanded matching: Sens: 93.3% Spec: 99.3%
- Impact of last known alive:
  - Worsens sensitivity
  - Improves specificity
- SSN is NOT necessary for high quality matching

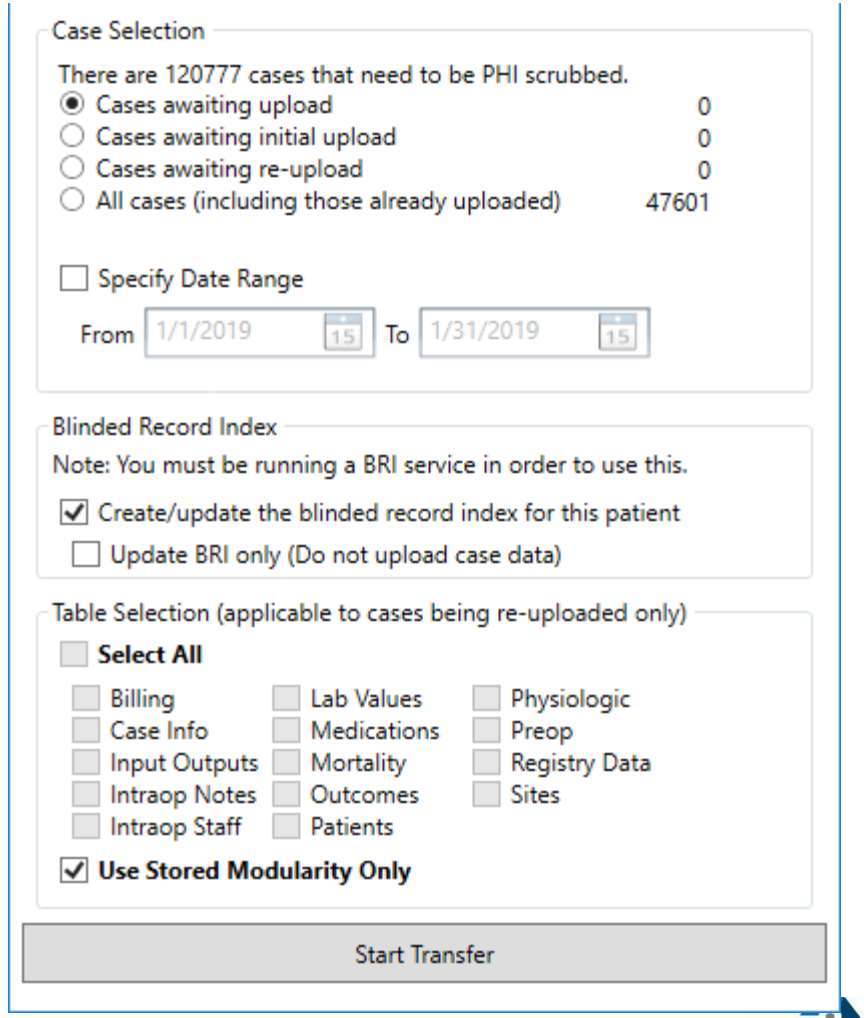
What next?

- Coordinating center
  - Signed contract with State of Michigan for Death Data
  - We will contact each MPOG site to begin uploading BRI data
  - We will start BRI'ing the state death data
- Each MPOG site
  - Work by your technical staff: < 1 minute
  - Work by your ACQR: < 5 minute
  - All software already installed and ready to go
- What we've learned
    - Do it in 2 phases: It takes a while 1 hour for 8,000 patients
      - Historical data first, then monthly data
    - It works

Historical Load



Monthly Load



MPOG
MULTICENTER PERIOPERATIVE OUTCOMES GROUP

Questions?