

GLIA

Revolutionizing Support
In the World of
Patient Data Collection



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Problem:

Excessive Administration leads to Poor Data Collection and Patient Care

- In 2014, Physicians reported **16-20%** of their weekly work was general **admin** *(Woolhandler & Himmelstein, 2014)*
- In 2021, clinicians spent 27% of their time with patients, but **49% on admin** *(Medical Economics, 2021)*
- Excessive Admin impacts Healthcare Services
 - Slows down workflow
 - Leads to increased Overtime
 - Disparate Systems can lead to catastrophic consequences
 - Delay in treatment
 - Missing PHI like allergies
 - Missing contraindicating Medications



At First...

Solution:

Consolidation of Patient Health Information (PHI)

- Consolidating PHI from Electronic Health Records and loose forms streamlines admin
 - Protect against hazards like fires and floods
 - Make complete information accessible sooner
- Using Optical Character Recognition (OCR), translate handwriting into electronic form
 - Ideal for AI integration

~~Solution:~~ Existing Solution

Consolidation of Patient Health Information (PHI)

- Consolidating PHI from Electronic Health Records and loose forms streamlines admin
 - Protect against hazards like fires and floods
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- Using Optical Character Recognition (OCR), translate handwriting into electronic form
 - Ideal for AI integration
- *Our idea was so good we learned that Amazon had done with its **AWS Health Services***
 - *Even down to the JSON formatting we had planned on using*
 - <https://aws.amazon.com/health/>

Amazon Web Services (AWS)

Healthcare and Life Sciences

- Provides a comprehensive package of PHI
 - Existing Conditions
 - Medications
 - Personal Information

```
"id": 1,  
"name": "John Doe",  
"age": 50,  
"condition": "Hypertension Diabetes",  
"medicine_info": "Lisinopril, Metformin",  
"past_medical_history": "High blood  
pressure since 2010, Type 2 diabetes"
```

```
"id": 2,  
"name": "Mary Smith",  
"age": 30,  
"condition": "Asthma",  
"medicine_info": "Albuterol",  
"past_medical_history": "Chronic  
respiratory issues since childhood"
```

Amazon Web Services (AWS)

Healthcare and Life Sciences

- Provides a comprehensive package of PHI
 - Existing Conditions
 - Medications
 - Personal Information
- *Isn't anonymized*

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"id": 1,  
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"medicine_info": "Lisinopril, Metformin",  
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Limitation

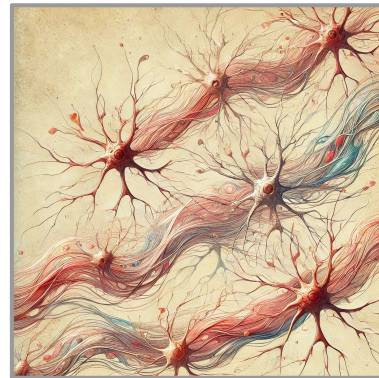
Privacy of Sensitive PHI

- Privacy concerns are limiting AI integration into Healthcare administration
- Other organizations, like EIS, offer some encryption support for AWS
 - But EIS is specialized and centralized through Amazon
 - Area is in its infancy and has opportunity for expansion
- With our decentralized encryption network, patient health data can be consolidated, protected and utilized in new formats that benefit both patients and healthcare providers
- *The key is a low-barrier-to-entry solution for easy integration into healthcare workflow with large downstream impact*



Why GLIA?

Glia are the Support network for Neurons



Our Glia Network will accelerate patient care with three goals.

1. Encrypting Patient Information → Digitizing Healthcare Records
2. Lower Barrier to Entry → Incentivizing Data Collection
3. Constructing Federated Learning → Collaborative Research



Encryption Demo

Encryption Demo

1. Encryption Setup:
 - a. A secure password and unique salt (randomly generated) are set for AES encryption
 - b. A Key Derivation Function (PBKDF2-HMAC-SHA256) derives a robust 256-bit AES key from the password and salt
2. Encryption Process:
 - a. Sensitive data is encrypted using AES in CBC mode with unique Initialization Vectors (IV) are padding
 - b. Each record is stored with encrypted fields and hashed keywords, creating a searchable index

```
Encrypted Records for Database Storage:
[
  {
    "id": 1,
    "name": "John Doe",
    "age": 50,
    "condition": "Hypertension Diabetes",
    "medicine_info": {
      "salt": "Lyqxe5JMYJAPVVB0a1afwA==",
      "iv": "GStdr8S1KjBfP+qEc8TTgQ==",
      "data": "+ABj5bt/6rfdMPMamL4BbDIW3ZGZAC1tTr8jkRhZnh0="
    },
    "past_medical_history": {
      "salt": "Lyqxe5JMYJAPVVB0a1afwA==",
      "iv": "23MDBzW7iGQZ6VZZ/hMjcQ==",
      "data": "FwWtdDjLTCXuq2vtP/dB9r2IDychUnD3pFzmR0CAwUUrEgGg1poK5GACpIWvfQ"
    },
    "keywords": [
      "cc5cc8d5ca1325a4a526118580a3a27b1f3821c734dcc9289b3a67e5d7ef027c",
      "c3311c4ca6df58c509e76fba2049d3d2e8c7256cd84fa19d2c3ccda6b372fb6d"
    ]
  },
  {
    "id": 2,
    "name": "Jane Smith",
    "age": 30,
    "condition": "Asthma",
    "medicine_info": {
      "salt": "Lyqxe5JMYJAPVVB0a1afwA==",
      "iv": "VBNbhifqfwZQUbWh/8c7Iw==",
      "data": "nV5k5bSdsp6WwL7BD8JAGg=="
    },
    "past_medical_history": {
      "salt": "Lyqxe5JMYJAPVVB0a1afwA==",
      "iv": "00DE6KKPyahotNi3n+0FGg==",
      "data": "G0kwocBdKp6Qg306S0I80mC7oQzZ8sciBunxv30FVxnJCI4P20RQ67FbG140jx0m"
    },
    "keywords": [
      "d83cf5e912a99a50810ddd fb8d442ee0bb5c59758217819e25f2e85f299ae8ed"
    ]
  }
]
```



Search and Retrieval

Search and Retrieval

(Cancer Use Case)

1. Password Protection:
 - a. The user must enter a password to retrieve decrypted records
 - b. If correct, matching records based on the keyword are decrypted and displayed
2. Search and Retrieval:
 - a. Keywords are hashed (SHA-256) for secure searching
 - b. When searching, records containing the hashed keyword are decrypted if the correct password is provided

Search Encrypted Data

Age: 26

Condition: Chronic Pain, Cancer

Pharma Info: Gabapentin, Montelukast

Medical History: Visited for Cancer in 2014

Age: 42

Condition: Bronchitis, Cancer

Pharma Info: Vitamin C, Vitamin C

Medical History: Visited for Cancer in 2021

Age: 65

Condition: Eczema, Cancer, Lupus

Pharma Info: Vitamin C, Fluoxetine, Vitamin C

Medical History: Visited for Eczema in 2013

Age: 75

Condition: Chronic Fatigue Syndrome, Vertigo, Cancer

Pharma Info: Atorvastatin, Vitamin C, Vitamin C

Medical History: Visited for Chronic Fatigue Syndrome in 2020

Age: 55

Condition: Anxiety, Cancer, High Cholesterol

Pharma Info: Lorazepam, Vitamin C, Vitamin C

Medical History: Visited for Cancer in 2023

Age: 67

Condition: Cancer, Glaucoma, Bipolar Disorder

Pharma Info: Ipratropium, Vitamin C, Alprazolam

Medical History: Visited for Cancer in 2023



Blockchain Integration for Secure Medical Record Storage



Blockchain Integration for Secure Medical Record Storage

- Encrypted Data on Blockchain
 - Stored with a unique, traceable hash ID
 - Immutable and tamper-proof
- Patient-Controlled Access:
 - Only the patient holds the decryption password-essential for unlocking data
- Traceability and Privacy
 - Blockchain provides a secure audit trail without exposing sensitive data
- Simple Retrieval
 - Patient uses their password which searches the hash ID to locate records and decrypts with their password

Medical Records

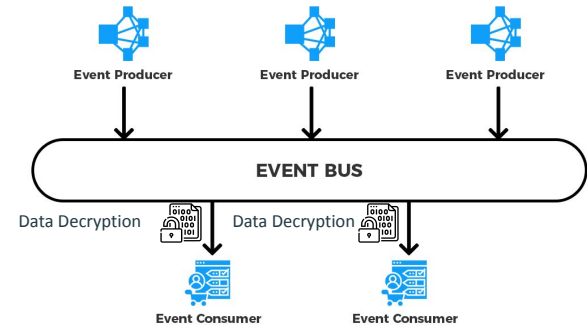
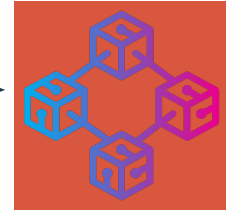


Lab Reports



Data Encryption

Blockchain Technology

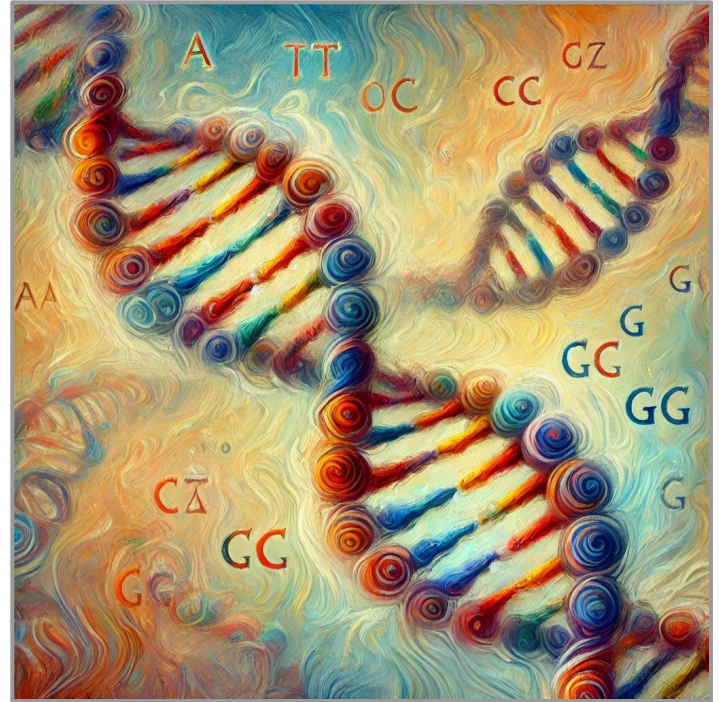




Moving Forward (Next Steps)

EHR as Digital Asset

- Medical records stored in Glia will be accessible only through the encrypted sequence
- Unlocks possibilities to utilize the data across locations
- Whenever the data is accessed, it maintains its encryption

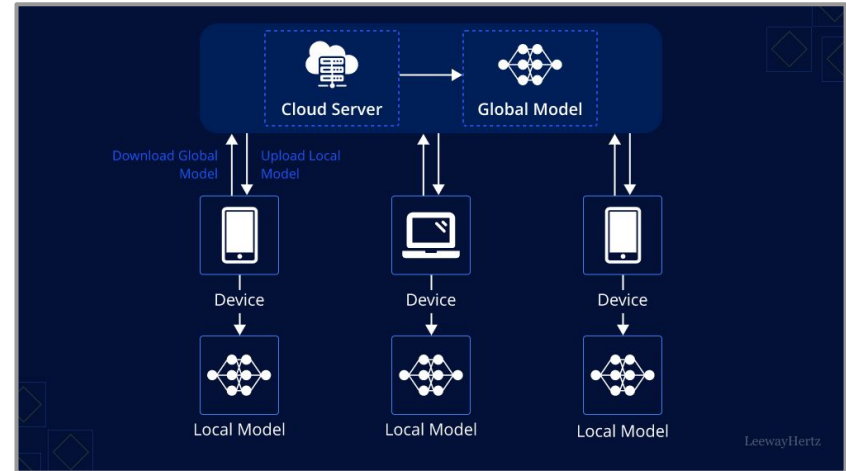


Similar to a base sequence of DNA, each encryption is unique to each patient, storing the information sequentially to relate to their patient history

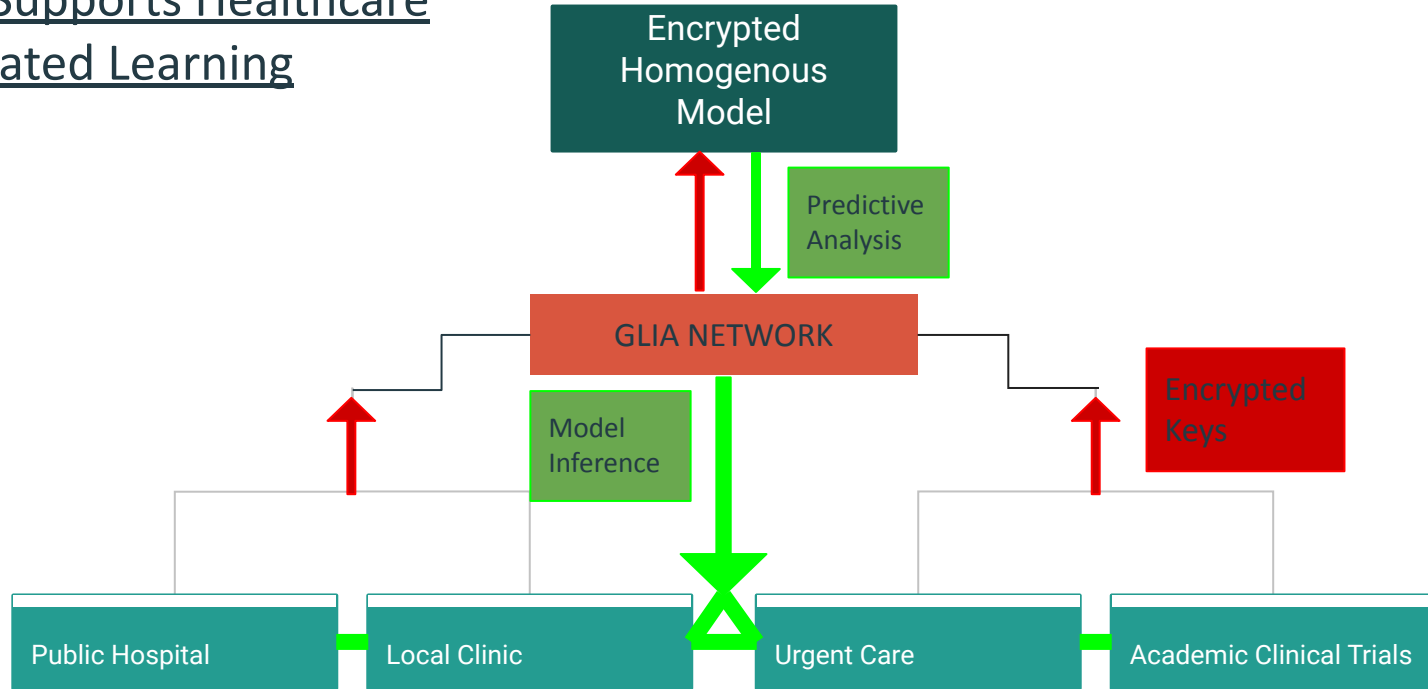
Federated Learning Potential

Federated Learning is a machine learning technique that trains AI models in a decentralized way, without exchanging data between devices

Limitations: Data Heterogeneity, Communication, and Privacy



GLIA Supports Healthcare Federated Learning



The Encrypted Keys are the Mechanisms → Preserves Anonymity & Retains only necessary Information

Pros

- Both patients and hospitals have **easy access** to patient data
- Supports integration of current platforms for managing patient health data
- Maintains PHI **anonymity** and **security**
- Allows for anonymous search of all patient records while preserving privacy
- **Saves time** for already-overworked healthcare providers
- A variety of applications:
 - Population data
 - Medical trials
 - Infectious Disease Forecasting

Cons

- Potential for data breaches
 - We address this by encrypting all data securely
- Potential for an AI to regurgitate sensitive patient data on request
 - Solution - Apply similar mechanism to Open AI's "ChatGPT Enterprise" model to protect sensitive data
 - Ally with governing agencies like the HHS for compliance and to increase confidence

Future Potential

- Lifetime data tracking for personal benefit, paired for individual (independent of location, provider)
- Potential for lifestyle data integration for healthcare tips or learning potential for users
- Forecasting susceptible conditions based on population norms of statistical determinants
 - (using permissible PHI to determine threat level over time of developing conditions)
 - Beneficial for genetic predispositions or family history of conditions like Alzheimer's or Diabetes
- Potential for license to grant clinical trials limited access for relevant analysis with large data that is representative of the population while maintaining anonymization of patient health information
 - Sharing inference, not complete set (Google Maps traffic red line)
- Other options of building out the package for other methods of administrative optimization
 - Automatic inventory digital twin generation
 - Scheduling updating
 - Intake
- Prevention/signaling in contagion outbreaks (CDC)
- Lower threshold to access medication/treatment by reducing overhead (rural areas, underserved populations)
 - Critical in expanding access to psychopharmacological interventions in novel Mental Health treatment
 - i.e. Veterans treating PTSD with psilocybin

References

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Medical Economics. (2021, January). *Top challenges 2021: #1 Administrative burdens and paperwork*.
<https://www.medicaleconomics.com/view/top-challenges-2021-1-administrative-burdens-and-paperwork>

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Any Questions?

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