

FEDERATED ARTIFICIAL INTELLIGENCE: ACCESS TO EXPERTISE AND DATA

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- The authors have no relevant disclosures.



OVERVIEW

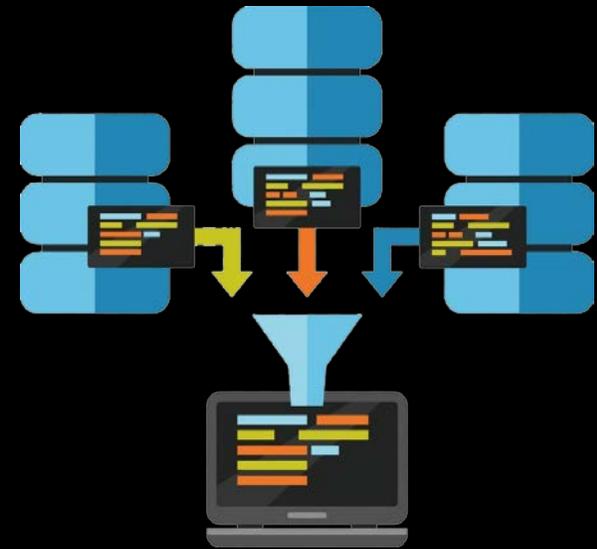
- Artificial intelligence in medical imaging
- Conventional artificial intelligence (AI) model development
- Federated Learning (FL) models of AI development
- Advantages and challenges in FL models

INTRODUCTION

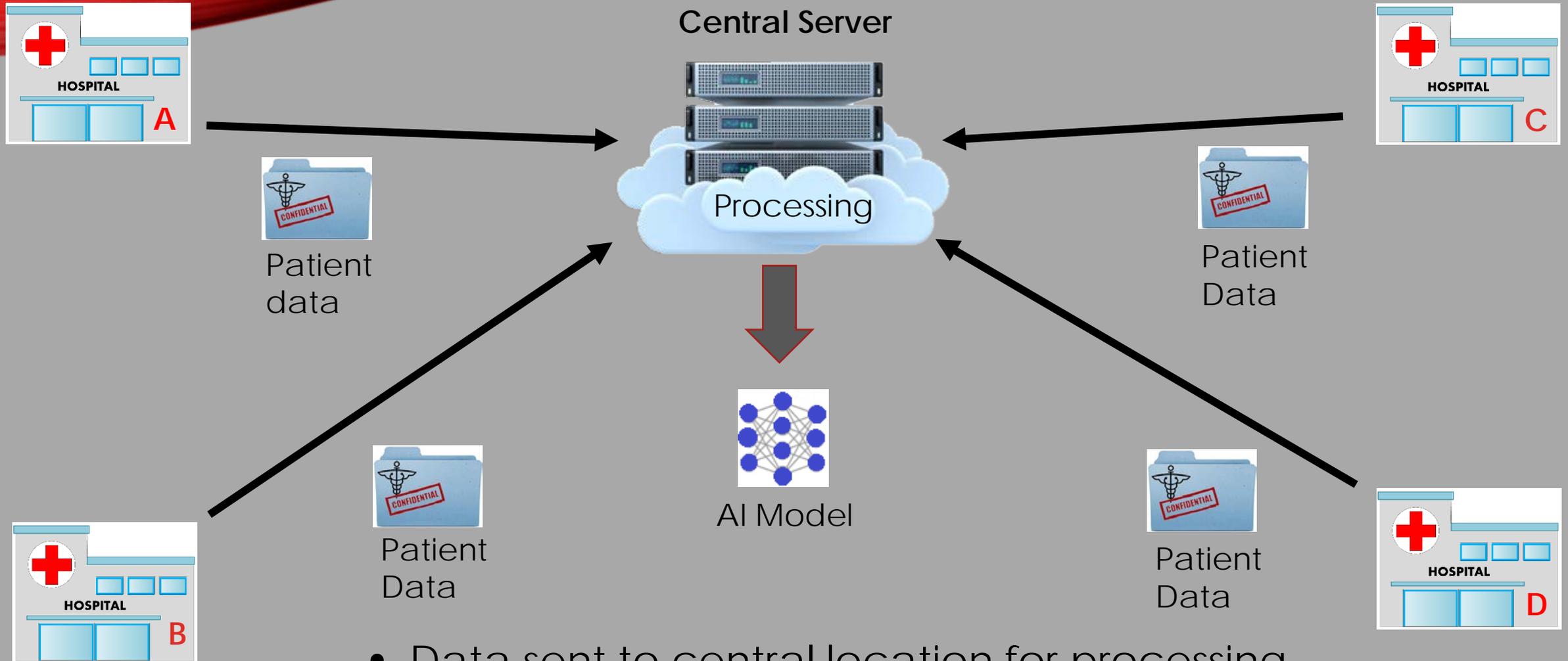
- Medical imaging workflow is primed for expedition and augmentation by artificial intelligence (AI)
 - Numerous fields have improved results and decreased costs with integration of AI models into clinical workflow
- “Training” machine learning AI models requires large amounts of data and computational power
- Access to AI models is imperative across a range of institutions of varying sizes, resources, and locations

CONVENTIONAL LEARNING MODELS

- Centrally located data server receives and processes data
 - High upfront costs
 - Limited to large academic institutions
- Relatively small datasets
 - Sampling bias may reduce generalizability of models
- Difficulty collecting and securing patient data
 - Requires negotiation between institutional data firewalls
 - Increased risk of data compromise



Conventional AI Learning

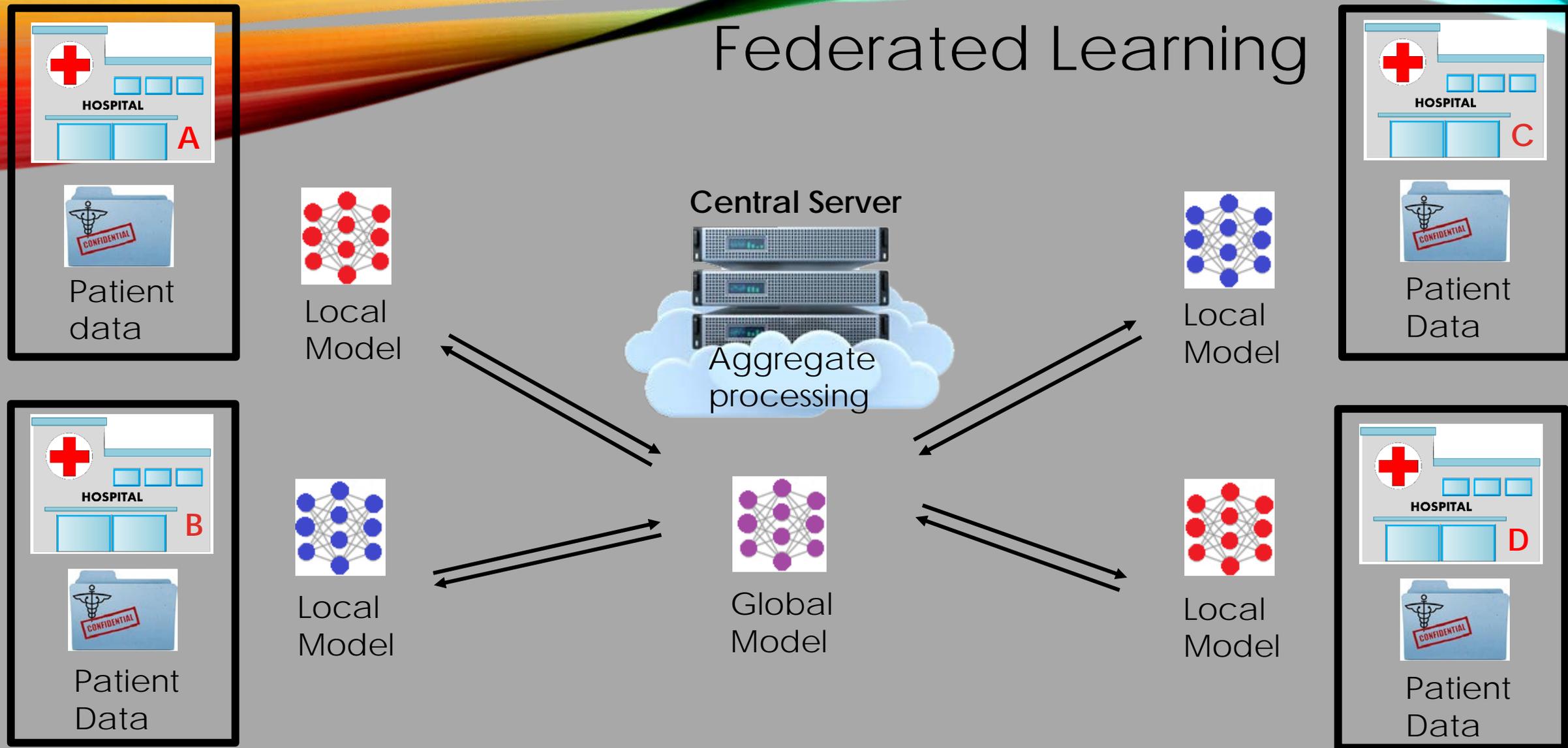


- Data sent to central location for processing
- AI model is generated centrally, then distributed

FEDERATED LEARNING

- Distributed network of multiple devices train local models with private datasets
- Local models are integrated into a global model
- Global model is redistributed for further training at local sites
- Datasets are not shared between institutions

Federated Learning



- Global model is trained with locally contained datasets to generate local model
- Local models integrated into global model

FEDERATED LEARNING ADVANTAGES

- Large and rapidly scalable data pools
 - Aggregation of small datasets
 - Facilitates higher quality model training
- Maintain security and privacy
 - Effective model development without sharing institutional data
 - Algorithms prevent reverse engineering of original dataset

CURRENT APPLICATIONS

- Existing studies have demonstrated robustness of FL-derived models
 - Prostate MRI imaging
 - Chest CT abnormalities in COVID-19 patients
 - Mammographic breast density classification
 - Brain tumor segmentation
- Comparable results to AI models with complete inter-institutional data sharing

CHALLENGES

- Assigning weights to models
 - Removing low quality data without biasing datasets
- Standardization of labeled datasets
 - Optimal integration relies on consistent labelling of datasets used to train models
 - Possible utilization of natural language processing algorithms in existing imaging reports
- Allocating resources
 - Determining value added to global FL models
 - Volume vs. case diversity

CONCLUSION

- Federated learning is a robust process for developing AI models with training from diverse pools of data
- Development of FL-derived models protects patient privacy and data
- Collaboration facilitates model development and distribution
 - The American College of Radiology AI-LAB initiative is inviting institutional participation in developing a COVID-19 classification model using a FL model

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