ASCAPE Framework and Technical Innovations

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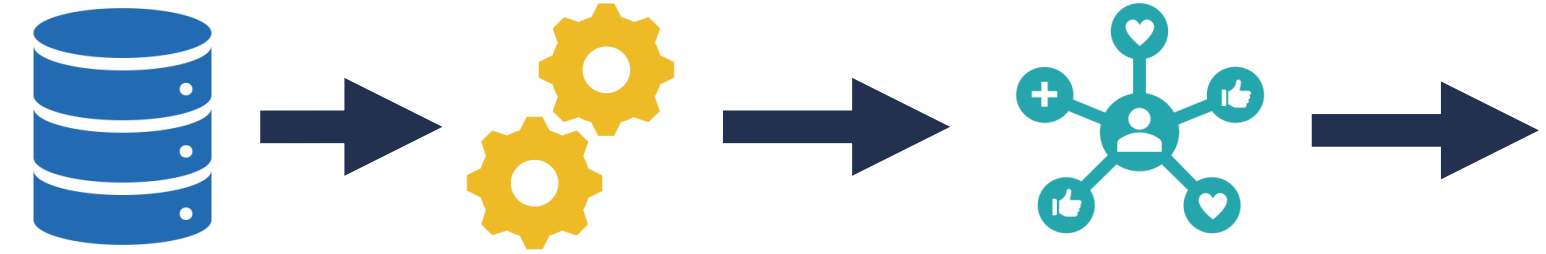
German Research Center for Artificial Intelligence (DFKI)

Data-driven ML-based Support for Personalized Healthcare



Cancer Patient Data

Machine Learning (ML/AI)

Personalized AI Services for QoL

Cancer Patient Treatment

- ASCAPE Edge Node in healthcare premises
- Use ASCAPE AI analytics on data of own patients
- Using QoL global predictive models provided by ASCAPE
- Using QoL predictive models trained on own patient data
- Obtain QoL risk predictions, model-based suggestions of interventions

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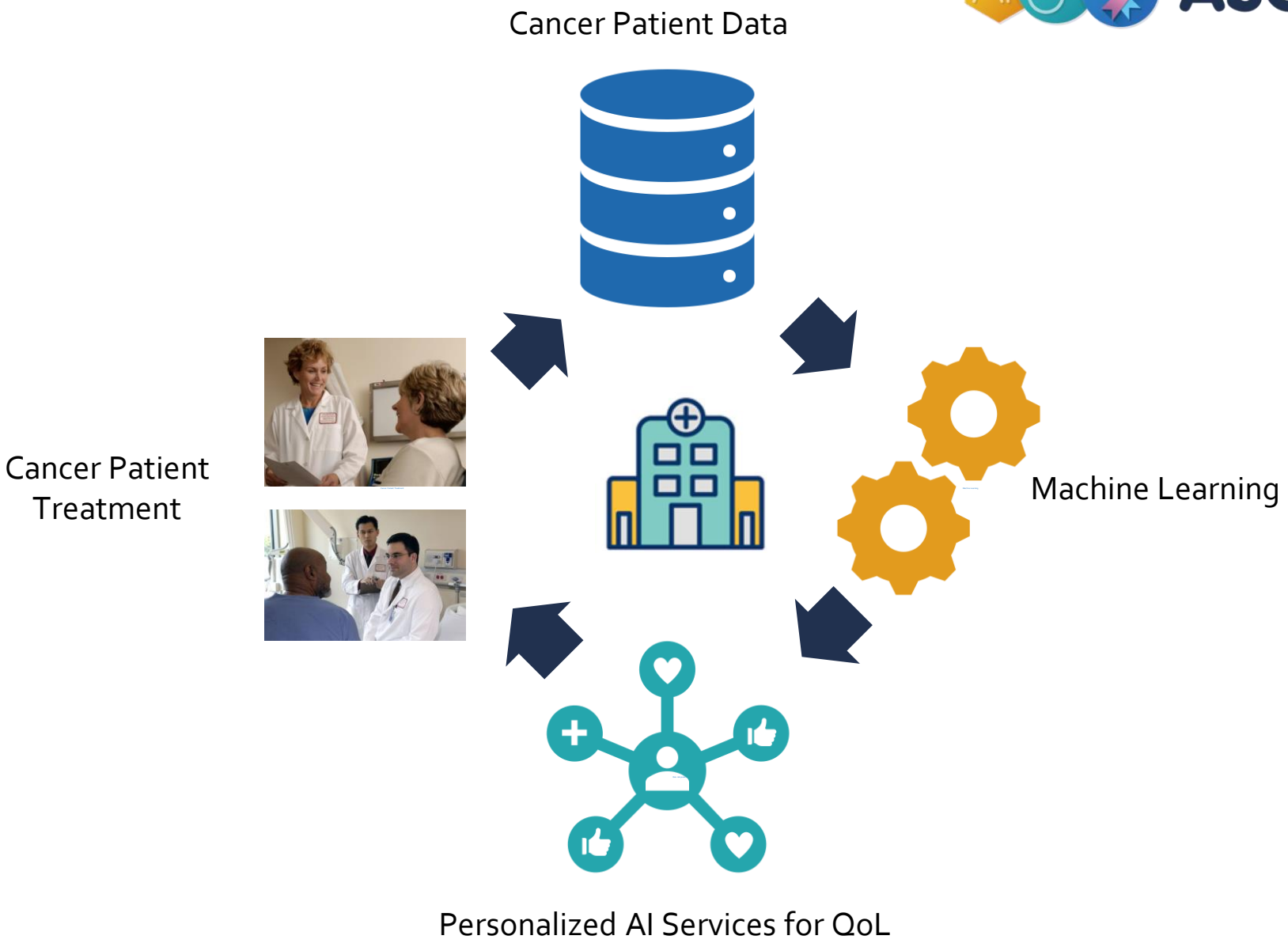
Continuous Data Collection and Learning



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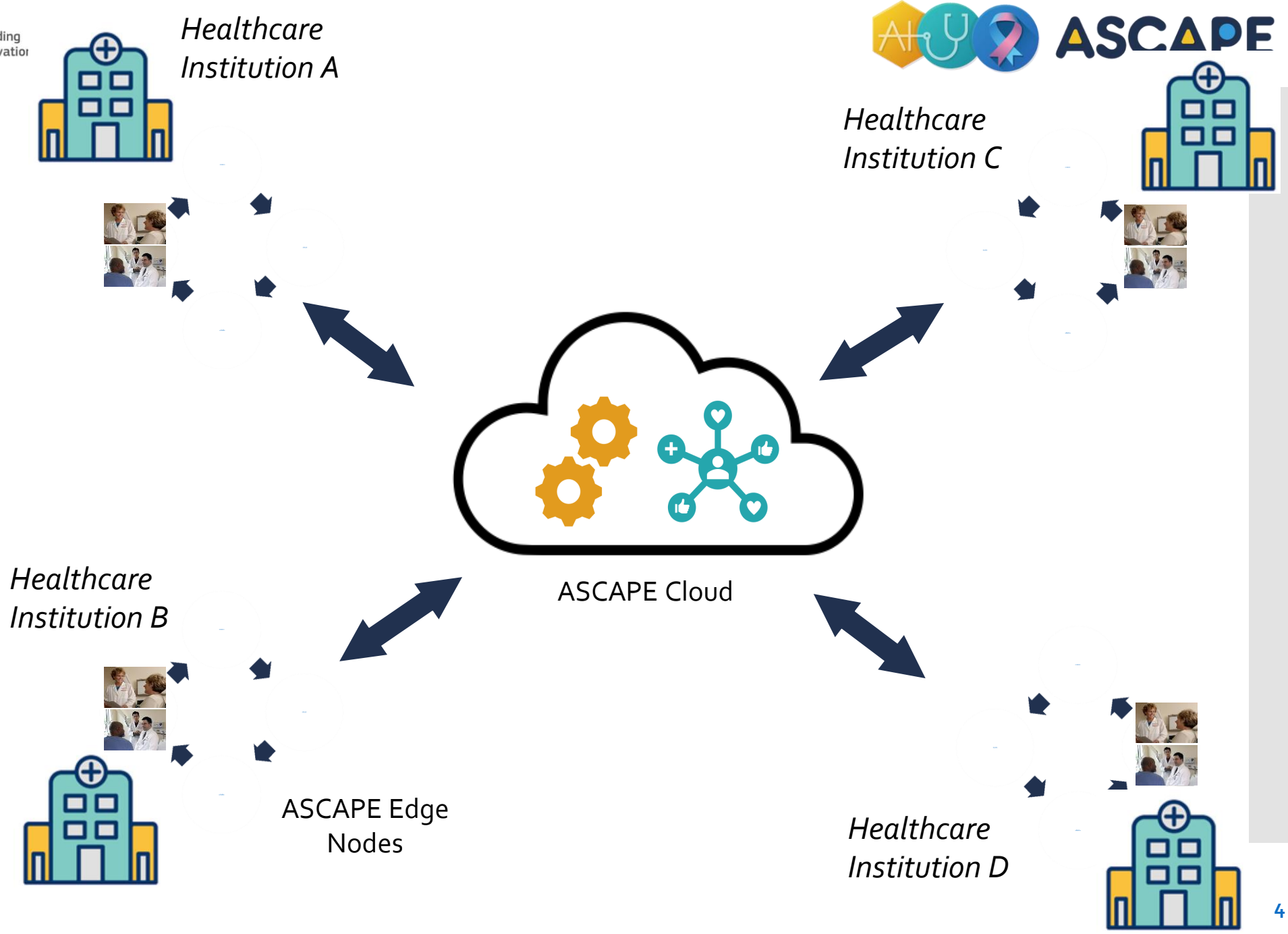
Cooperative. Distributed. Open.



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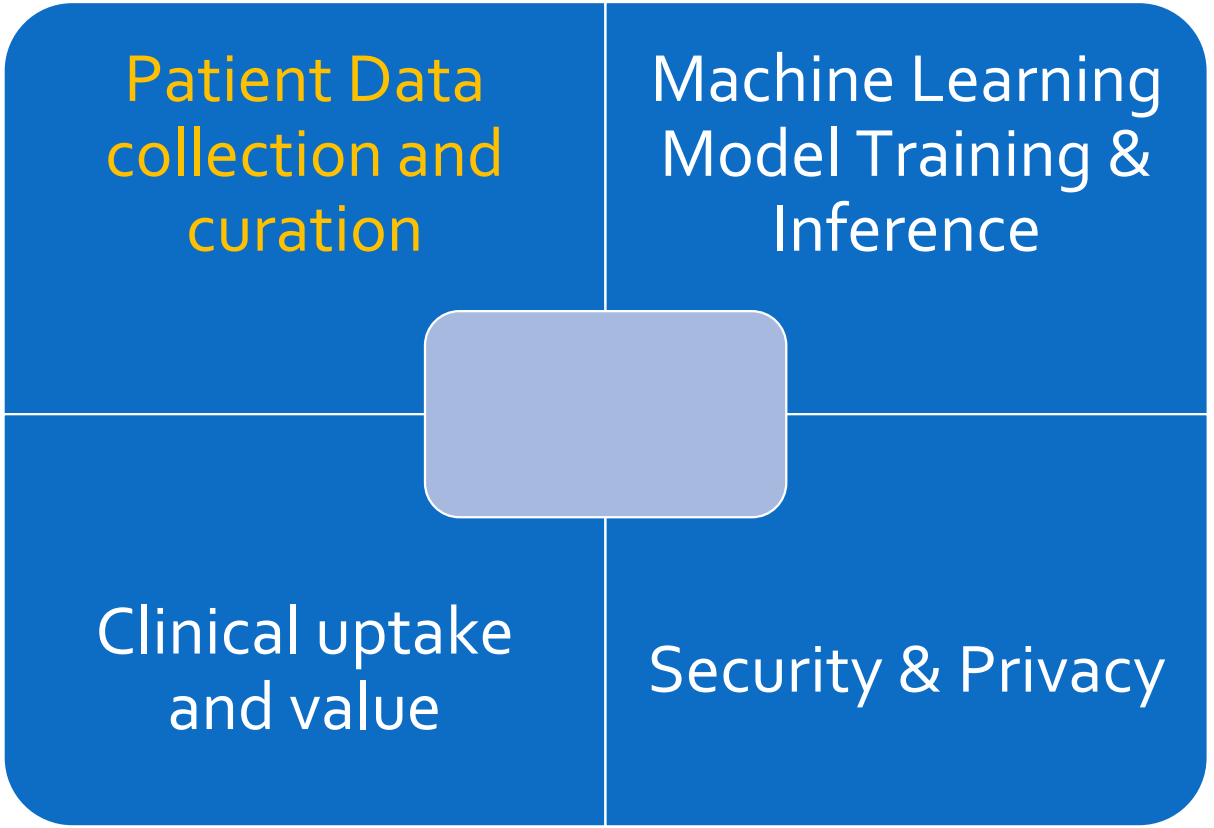
Technical Topics



ASCAPE Data Collection and Curation

Variables relevant for Quality-of-Life

- Cancer-type specific medical data from **electronic health records** (EHRs) including **interventions**
- **Quality-of-Life** from validated questionnaires
- **Nutritional information** from validated questionaires
- **Physical activities** from wearable devices
  - Support to directly collect data from wearable vendor cloud
- Contextual variables possibly affecting QoL or adherence to interventions from **open databases** (e.g. weather/ seasonal data, socio-economic status of the neighbourhood)
- HL7 FHIR-compliant format

Data Curation inside Edge Nodes

- All data aggregated and sampled to **examination dates**
- Pre-processed ready to use for ML training and analytics (CSV file format)

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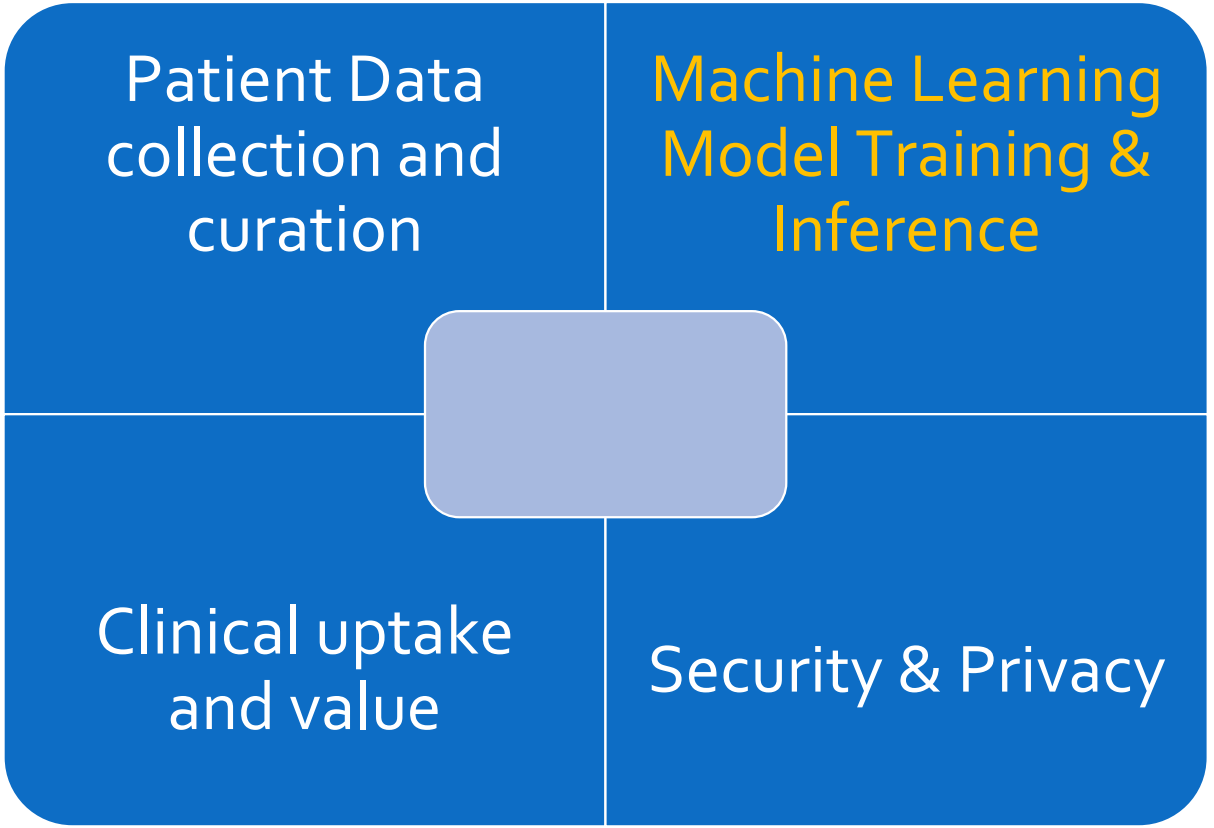
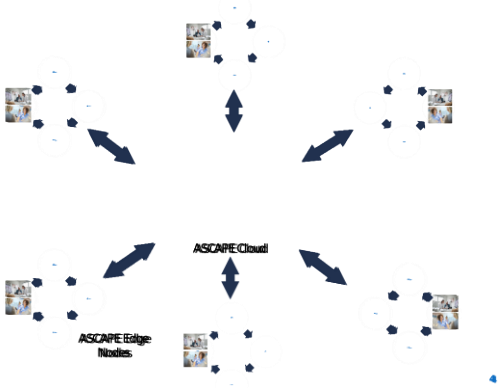
Technical Topics



Machine Learning Model Training & Inference

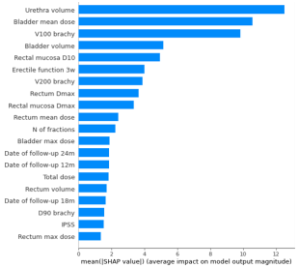
Model Training

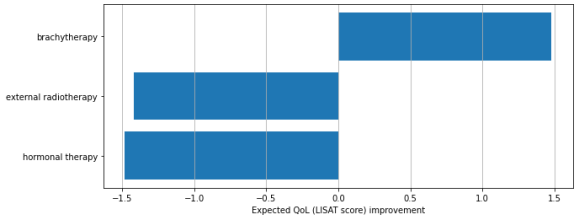
- Federated learning supports **dynamic re-configuration of the federation** (i.e. change of participating clients)
- **Machine learning algorithms on homomorphic encrypted** patient datasets
- **Continuous learning** from patient data updates (add, remove, update)



AI Analytics

- **Best models selection** for QoL risk predictions, explanations of predictions and simulations
- **Key variable identification** impacting QoL according to models
- Simulations to suggest best **interventions**





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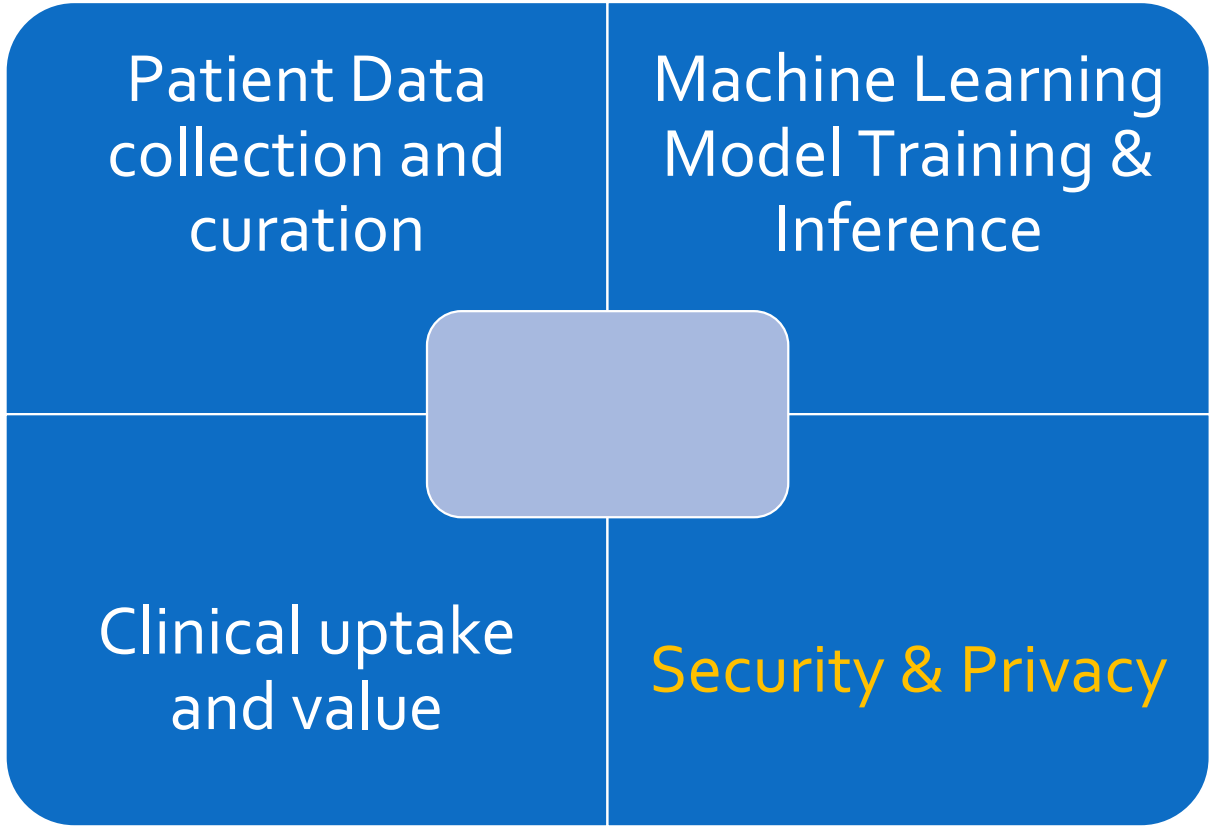


Security of Distributed System

Security by Design:

- **Security and Privacy mechanisms** designed based on Common Criteria (CC) Framework for the distributed ASCAPE edge nodes and cloud

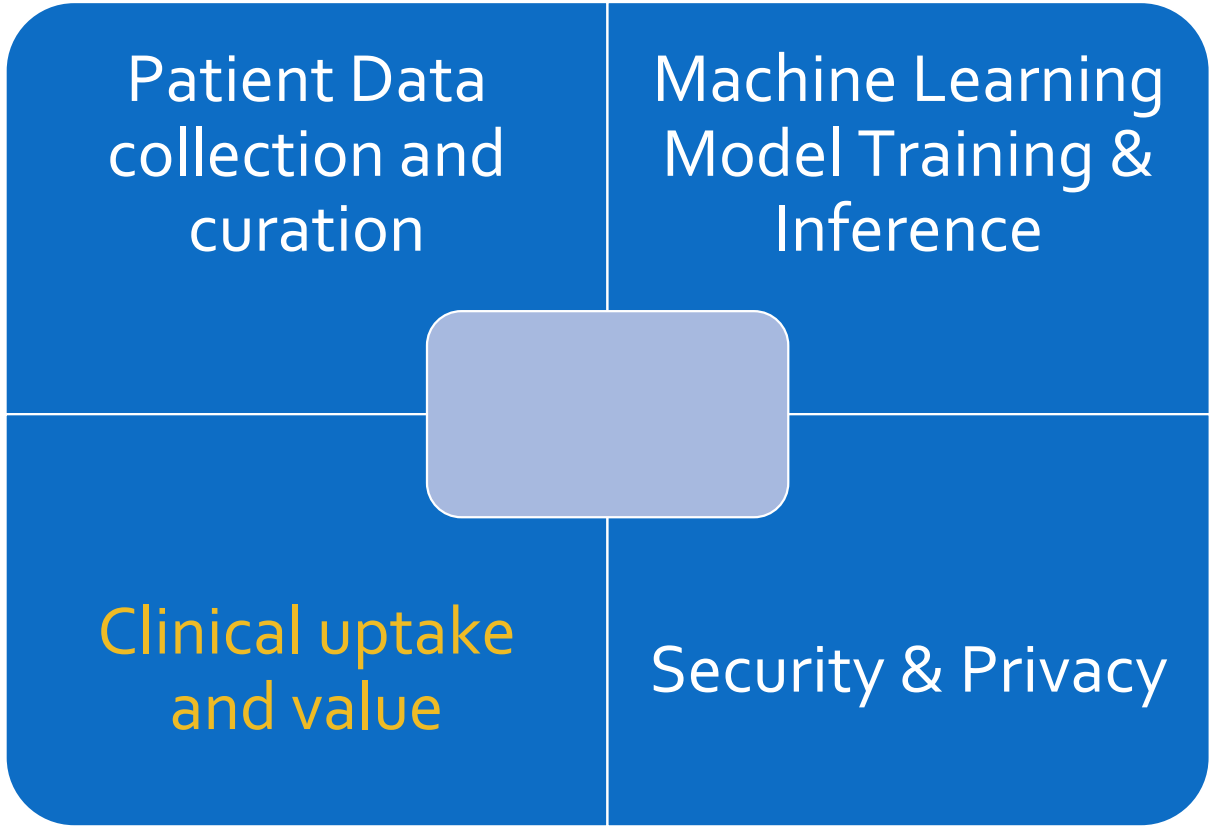
Security

- Access-control to edge nodes and cloud managed by WSO2 identity server and API manager

Privacy-by-Design by Privacy Enhancing Technologies

- **Goal:** Prevent direct or indirect disclosure of personal data
- Two-level **de-identification** between EHRs and ASCAPE AI Framework
- **Differential privacy** to prevent indirect disclosure from ML models
- **Federated Distributed Learning:** unencrypted patient data at HIS sites only
- **Model training over homomorphically encrypted** patient data on the ASCAPE cloud

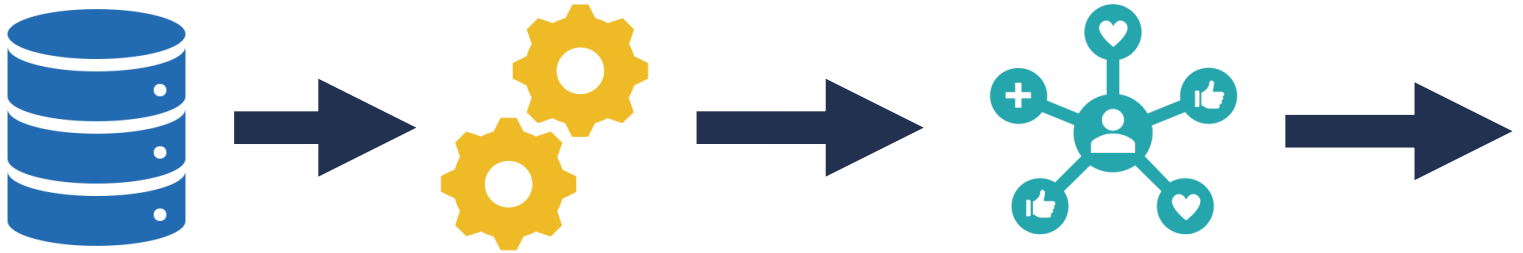
Technical Topics



European Commission | Horizon 2020 European Union funding for Research & Innovation

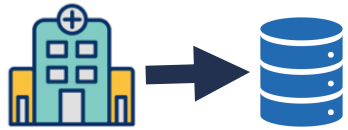
ASCAPE

Seamless integration of ASCAPE AI Services into healthcare practice



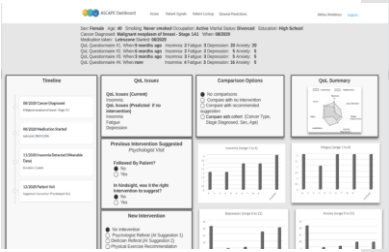
Patient Data Collection

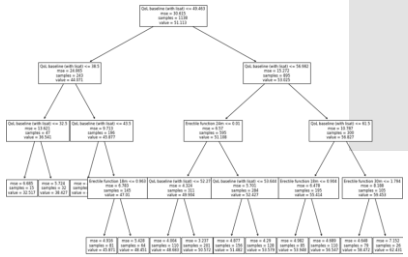
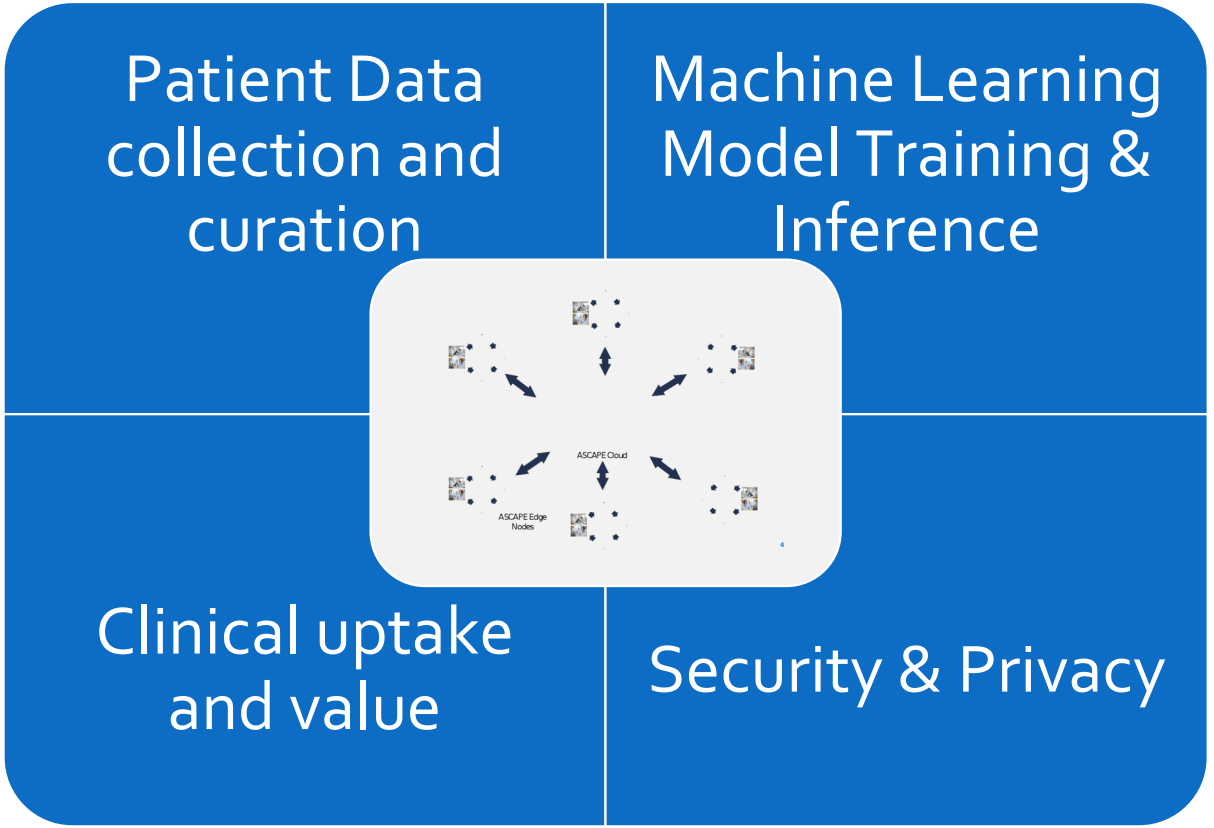
- Connectors and converters to transform healthcare EHR data into ASCAPE data format
- (User) Interfaces to setup ASCAPE to collect wearable data from individual patients



Access to and Use of AI Results

- (User) Interface for medical personnel
- Intuitive visualizations of AI results
- Validation & Use of predictive models
- Explanations for AI predictions and suggestions





Thank you for your attention