Enabling Personalized Interventions (EPI)

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Project Goal

- "The overall aim of this project is to explore the use and effectiveness of data driven development of scientific algorithms, supporting personalized self- and joint management during medical interventions / treatments.

- The key objective is to use data science promoting health practically with data from various sources to formulate lifestyle advice, prevention, diagnostics, and treatment tailored to the individual, and to provide personalized, effective, real-time feedback via a concept referred in this proposal as a digital health twin."

Research questions:

1. Dynamically Analyzing Interventions based on Small Groups: how can we determine, based on as little data as possible, whether an intervention does or does not work for a small group or even an individual patient?
2. Dynamically Personalizing the Group: how can we identify effective intervention strategies and optimize personalization strategies applicable for different patient and lifestyle profiles via dynamic (on-line) clustering of patients? Can those clusters be adapted as new data about patients and results of interventions come in and as other data may be removed or modified?
3. Data and Algorithm Distribution: what are the consequences of a distributed, multi-platform, multi-domain, multi-data-source big data infrastructure on the machine learning algorithms and what are potential consequences on performance?
4. Adaptive health diagnosis leading to optimized intervention: how can we enhance self- / joint management by dynamically integrating updated models generated from machine learning from various data sources in state of the art health support systems that based on personal health records, knowledge of health modes and effective interventions?
5. Regulatory constraints and data governance: how can we create scalable solutions that meet legal requirements and consent or medical necessity-based access to data for allowed data processing and preventing breaches of these rules by embedded compliance, providing evidence trails and transparency, thus building trust in a sensitive big data sharing infrastructure?
6. Infrastructure: how can the various requirements from the use-cases be implemented using a single functional ICT-infrastructure architecture?

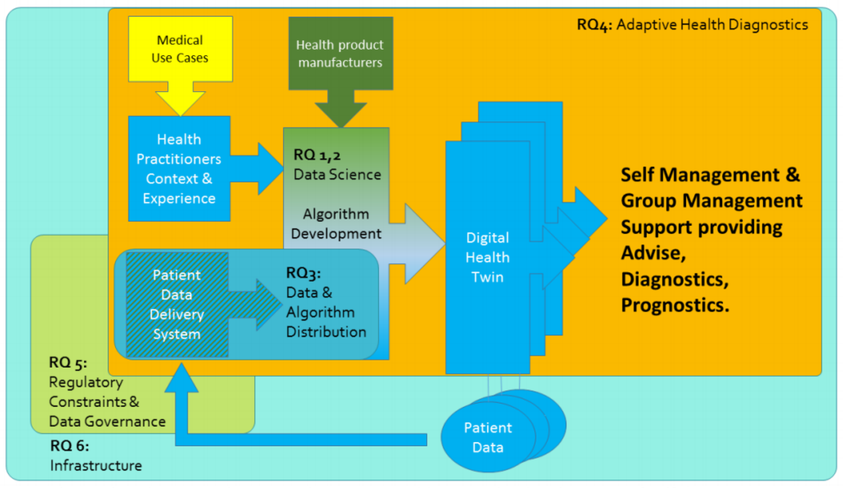

Fig. 1: Relationships between the research questions addressing the development of self-/group management applications.

Psychiatry use case
CWI, UMCU, Philips and Antes, PhD student Rosanne J. Turner

Problem: mental disorders are diverse, first 'standard' choice of treatment often ineffective
Goal: models that provide personalised treatment recommendations for mental disorders

	1. Data	2. Models	3. Evaluation & validation
Overall goals and approach	Aim: ability to exchange final algorithms with other parties • Data sources not specific to development hub • Smart data-preparation Include various data sources with structured and unstructured data ➡ big role for text mining	Aim: develop model that provides 1. Precise predictions 2. Insight into decision: especially in mental disorders ➡ try network approaches	Aim: provide sufficiently high level of evidence for model performance 1. Validation of trained models in partner mental hubs • Antonius • GGZ-Eindhoven 2. Prospective approach
Currently working on…	Add data preparation "pipeline" for EPI project to data flow at UMCU Include broad range of sources in pipeline: free text!	First example: train model for recommending treatment A or B in depression Exploring possible outcome measures with psychiatrists	Designing confidence/ performance measures depression model Planning validation study

EPI RQ3: Data and Algorithm distribution

Allaart CG[12], van der Nat P[2], van Halteren A[1], Dijksman LM[2], Biesma DH[2], Bal HE[1]
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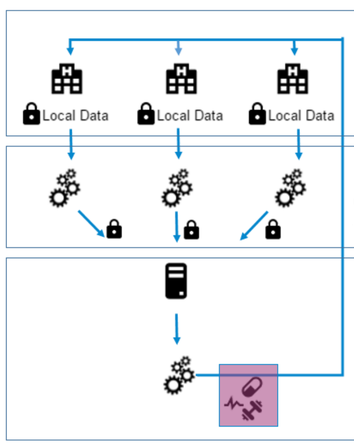


Privacy-sensitive data is spread out over different health institutions

Prediction models build on local data and send forward with encryption

Models are combined in a central location and send back to the institutions. This model can also be used to provide interpretable predictions

Use Case at St. Antonius Hospital
Cerebrovascular Accident (CVA)
- Improving CVA care based on Value Based Healthcare (VBHC)

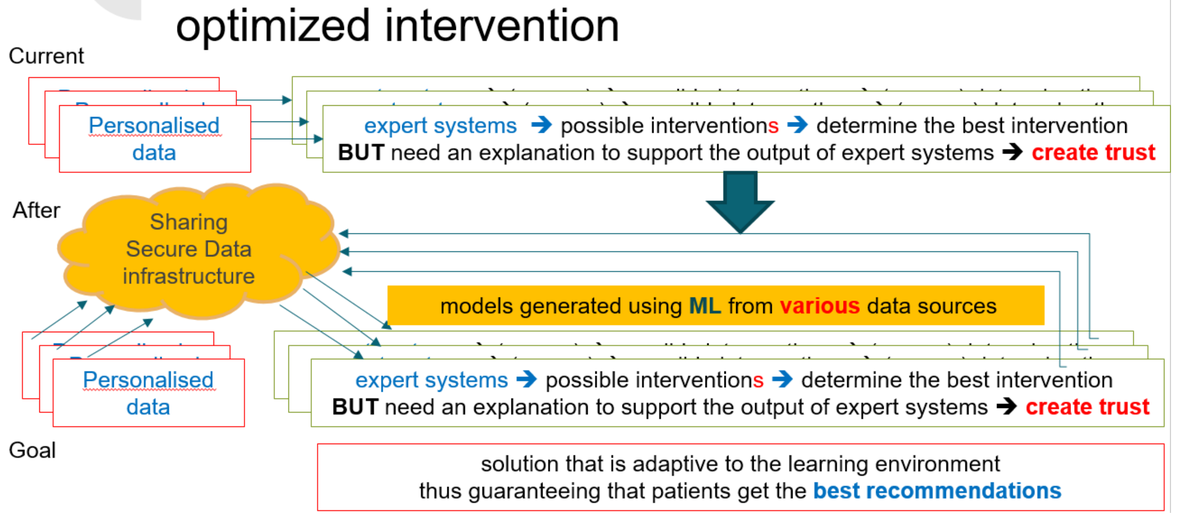
Value = The set of outcomes important to CVA / Costs of the complete care cycle

Aim to predict **post-acute phase** outcome indicators of patients with stroke (after 1 year)

Privacy-sensitive data is spread out over: Hospitals, GPs, Rehab clinics, Nursing homes

Current Challenges:
- Mapping the necessary and available data
- Creating a privacy preserving way to match patient identifiers from different institutions
- Combining the partial models to create reliable and interpretable predictions

RQ4: Adaptive health diagnosis leading to optimized intervention



Enabling Personalized Interventions [EPI]

Automated regulatory constraints and data governance for Healthcare

Use Case
- 700 Children data
- Diffuse Intrinsic Pontine Gliomas(DIPG)
- Missing automated way to manage Consent & compliance

Objective
- Open authorization and governance solution
- Automating regulatory constraints
- Preventing breaches by embedded compliance
- Able to trace back any decision

Current work
- What is the state of the art for consent management in healthcare?
- Capture the current consent management framework in the Princess Maxima research center

RQ6 - Infrastructure: how can the various requirements from the use-cases be implemented using a single functional ICT-infrastructure architecture?

An infrastructure should secure data sharing between the health cycle stakeholder. Infrastructure architecture must support use-cases where data from different sources, governed by different owners, is processed by other organisations performing analyses extracting value to achieve a commonly agreed benefit.

Ideally, the architecture of this infrastructure would be dynamic, with respect to ISAs requirements (information sharing agreement), and the flow of information within the same collaboration request would vary with time.