Mehr als KI

-

Wie können wir aus Gesundheitsdaten Information generieren und in konkretes medizinisches Handeln übersetzen?

Berlin, 01. April 2022

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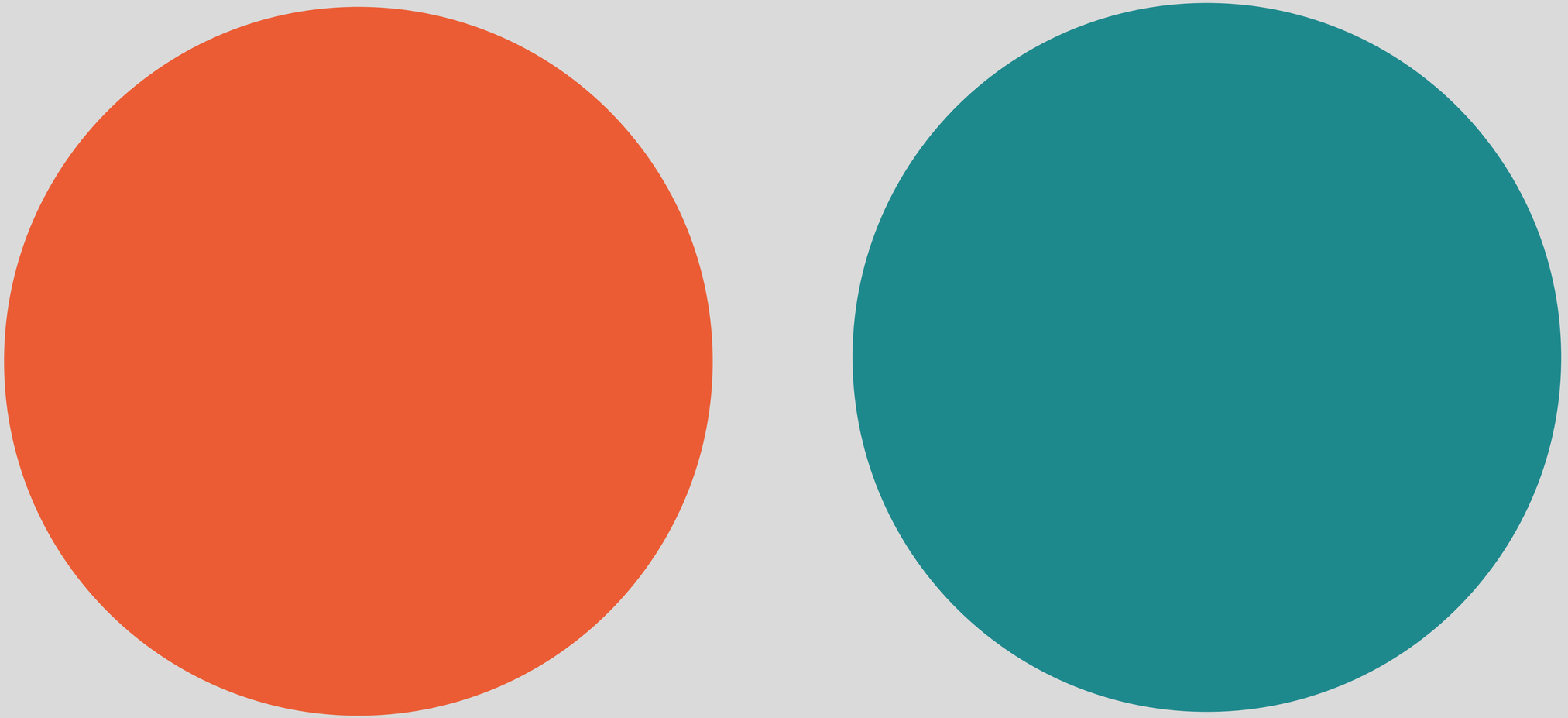
CLAIM Charité Lab for AI in Medicine
dietmar.frey@charite.de

CHARITÉ UNIVERSITÄTSMEDIZIN BERLIN
Federal Ministry of Education and Research
PRECISE4Q PREDICTIVE MODELLING IN STROKE

Charité 2007

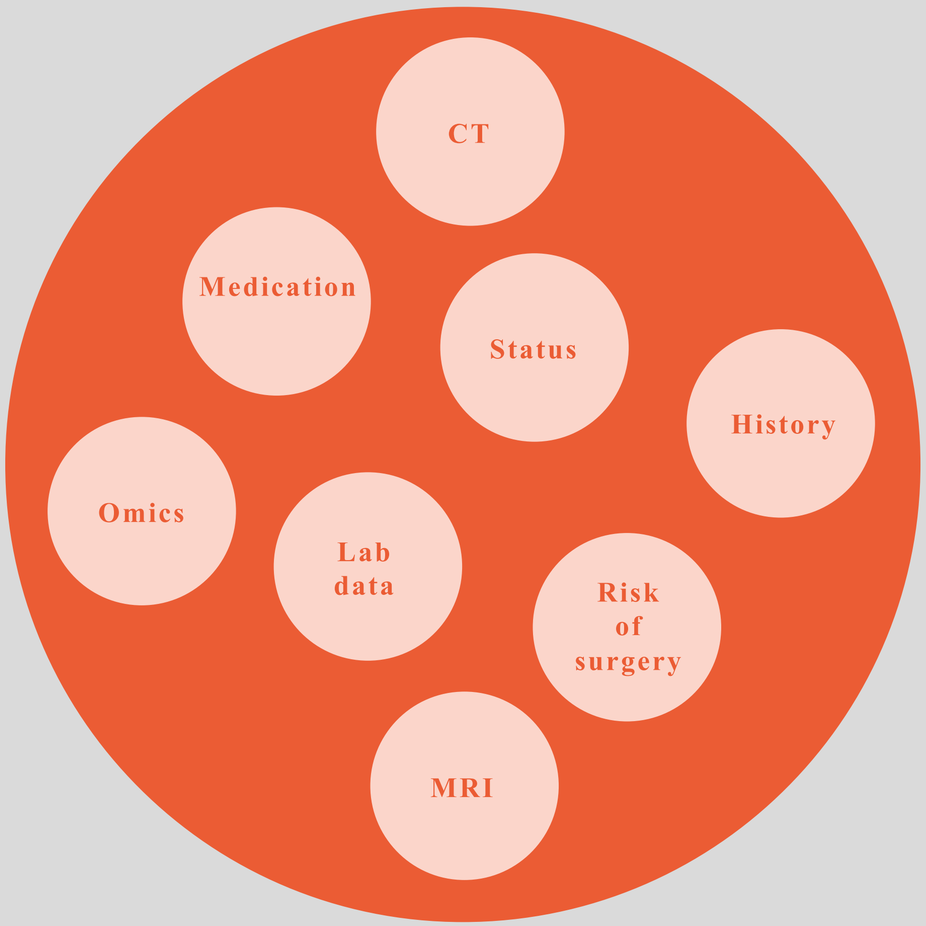
39 year-old female patient, s/p minor stroke

Charité 2007 consulting a junior resident doctor



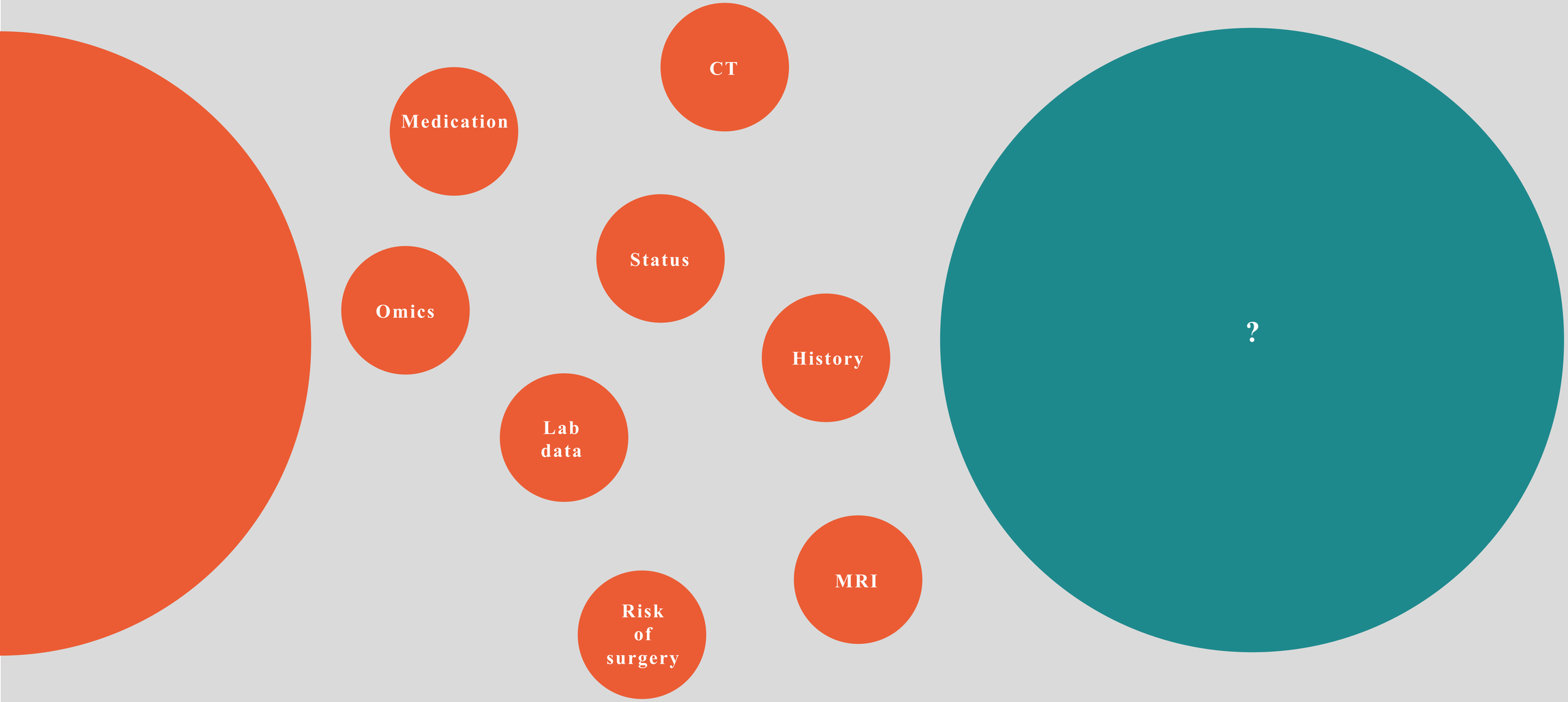
Charité 2007

In search for the best treatment
The patient provides various data



Charité 2007

How can we use all these data?



“All data that are acquired are intended to be used for prediction.“

“All data that are acquired
are intended to be used for prediction.“

But: Data are not available,
Not interpretable,
Not analysable

THE APPLICATION OF ARTIFICIAL INTELLIGENCE MEDICINE

n Coles

This article reviews current developments in artificial intelligence as they apply to medicine. Initial applications of this approach to medicine are being actively pursued in medical diagnosis, interpretation of data from chemical studies, and the development of computer models of human behavioural processes. Of special interest is a new research programme established at Stanford University called SUMEX, one of whose major goals is the application of artificial intelligence to medicine. Within the framework of SUMEX, research is actively under way in a number of aspects of biomedical research and clinical medicine. Some of the work reviewed includes the DENDRAL and META-DENDRAL programs, the Protein Crystallography System, SECS, MYCIN, DIALOG, CASNET, the Present Illness Program, PARRY, and Believer. Suggestions for future applications

Previously in AI …

Publication from 2017: same questions, more computing power

THE APPLICATION OF ARTIFICIAL INTELLIGENCE

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Artificial intelligence in medicine☆

Pavel Hamet, Johanne Tremblay***

Centre de recherche, Centre hospitalier de l'Université de Montréal (CRCHUM), Montréal, Québec, Canada, H2X 0A9
Department of Medicine, Université de Montréal, Montréal, Québec, Canada, H3T 3J7

ARTICLE INFO

Keywords:
Artificial intelligence
Robots
Future of medicine
Avatars

ABSTRACT

Artificial Intelligence (AI) is a general term that implies the use of a computer to mod
intelligent behavior with minimal human intervention. AI is generally accepted as havi
started with the invention of robots. The term derives from the Czech word *robota*, meani
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intelligent machines, was officially born in 1956. The term is applicable to a broad range
items in medicine such as robotics, medical diagnosis, medical statistics, and huma
biology—up to and including today's "omics". AI in medicine, which is the focus of th
review, has two main branches: virtual and physical. The virtual branch includ

Previously in AI …

But: No real progress for patient!

THE APPLICATION OF

ARTIFICIAL INTELLIGENCE

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Previously in medicine…

Study patient: male, caucasion, 50 years old

1st generalization in data acquisition

2nd generalization in treatment (Standards)

How do we treat the individual patient?

In an ideal world

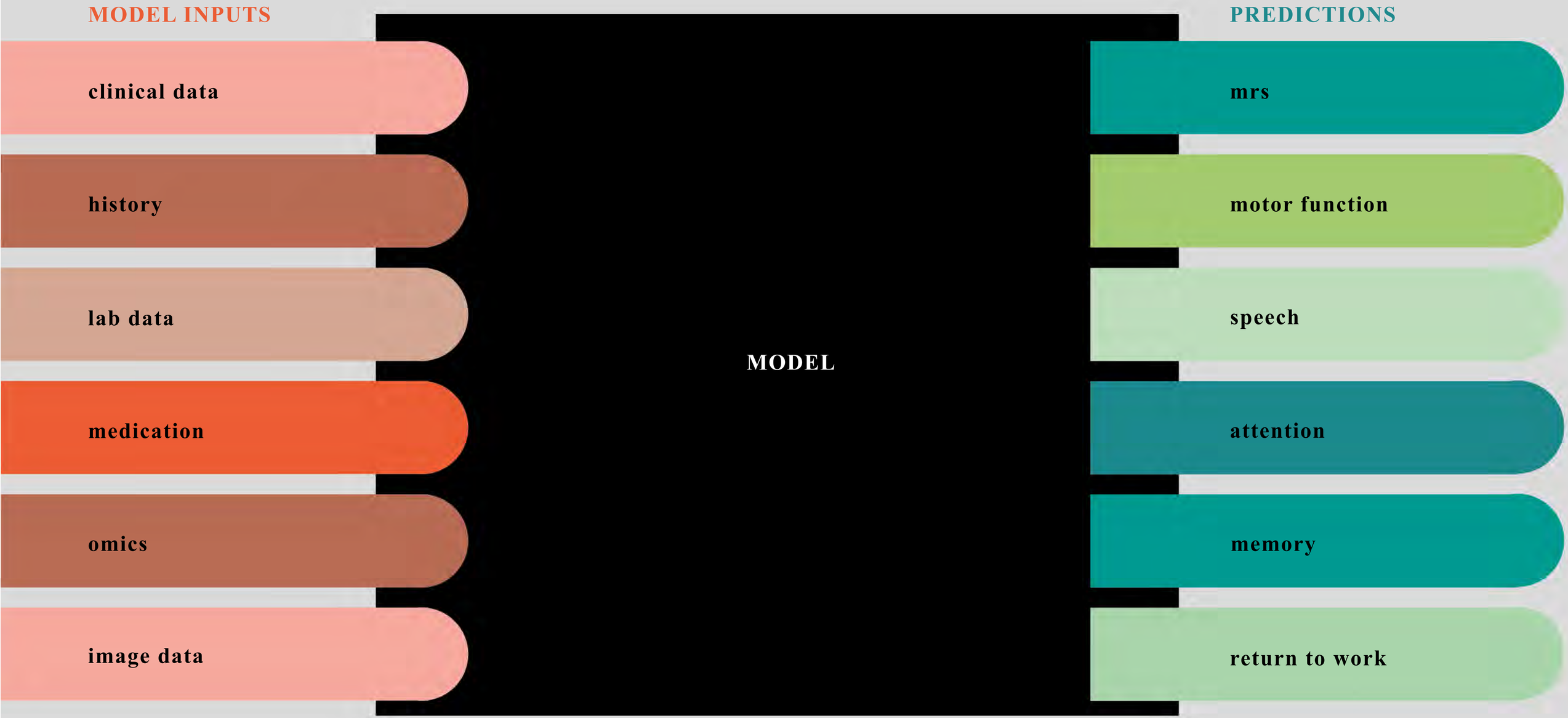
Patient-centered

Personalized

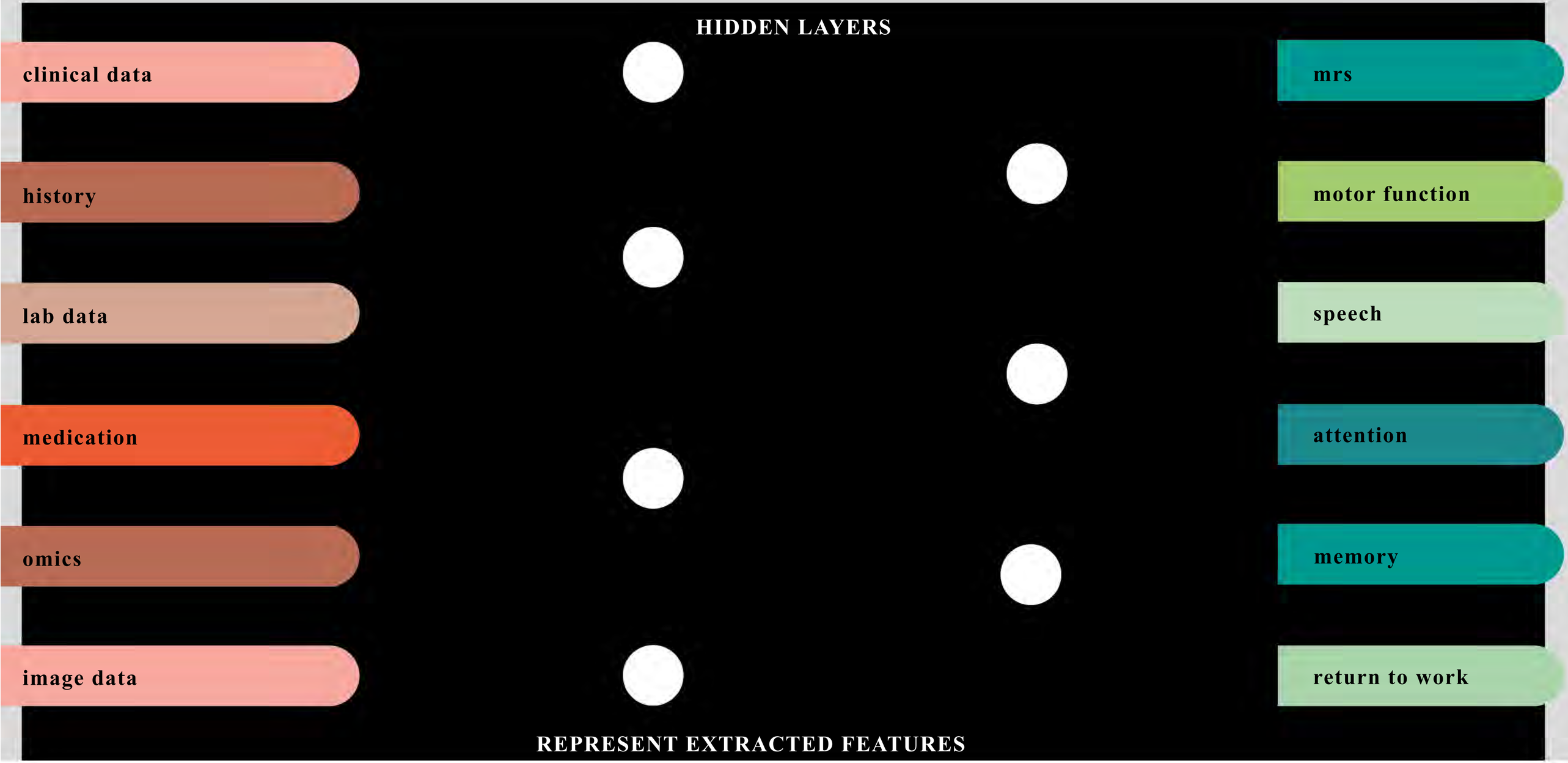
Predictive

The idea

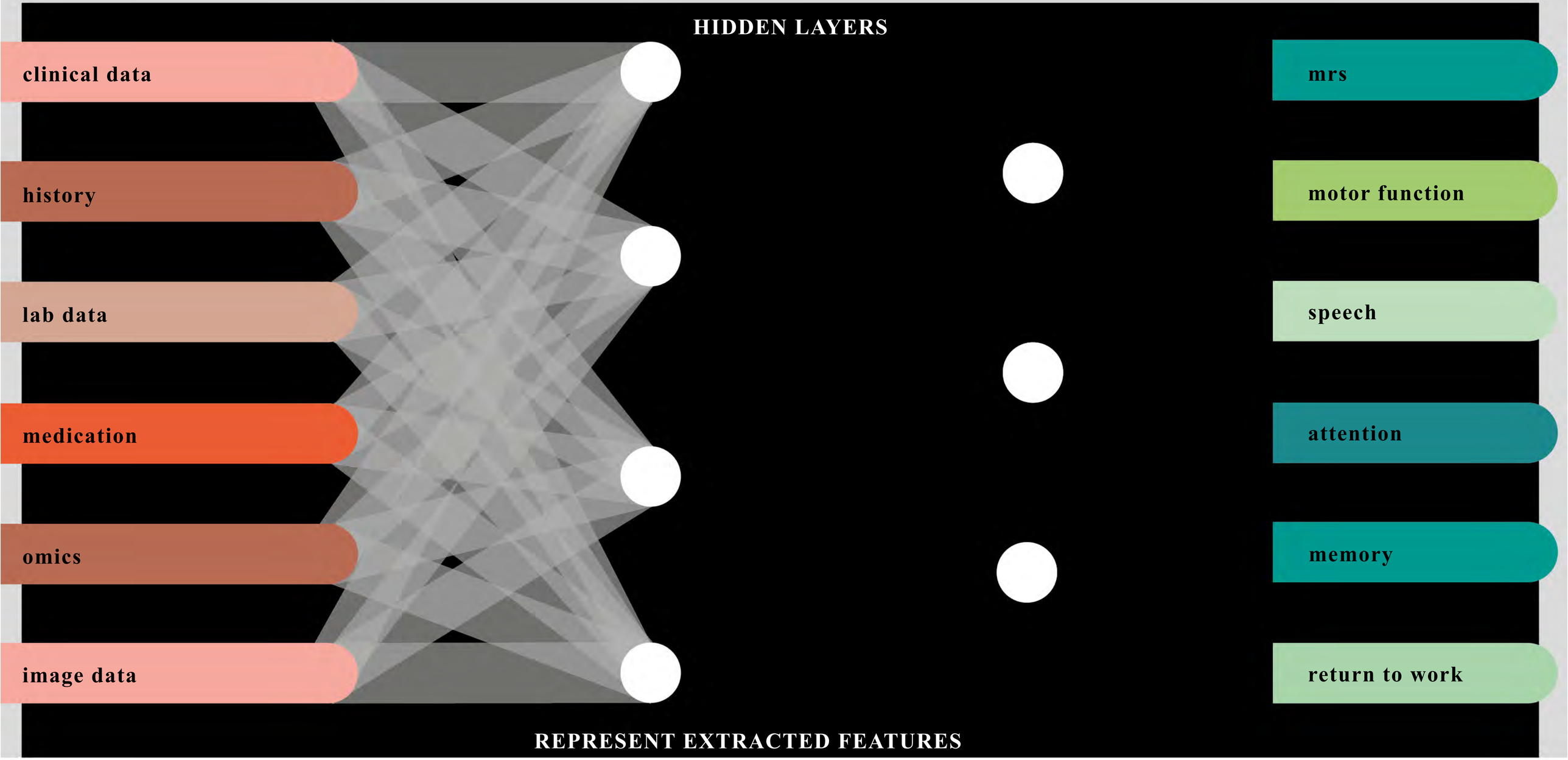
Application of Machine and Deep Learning



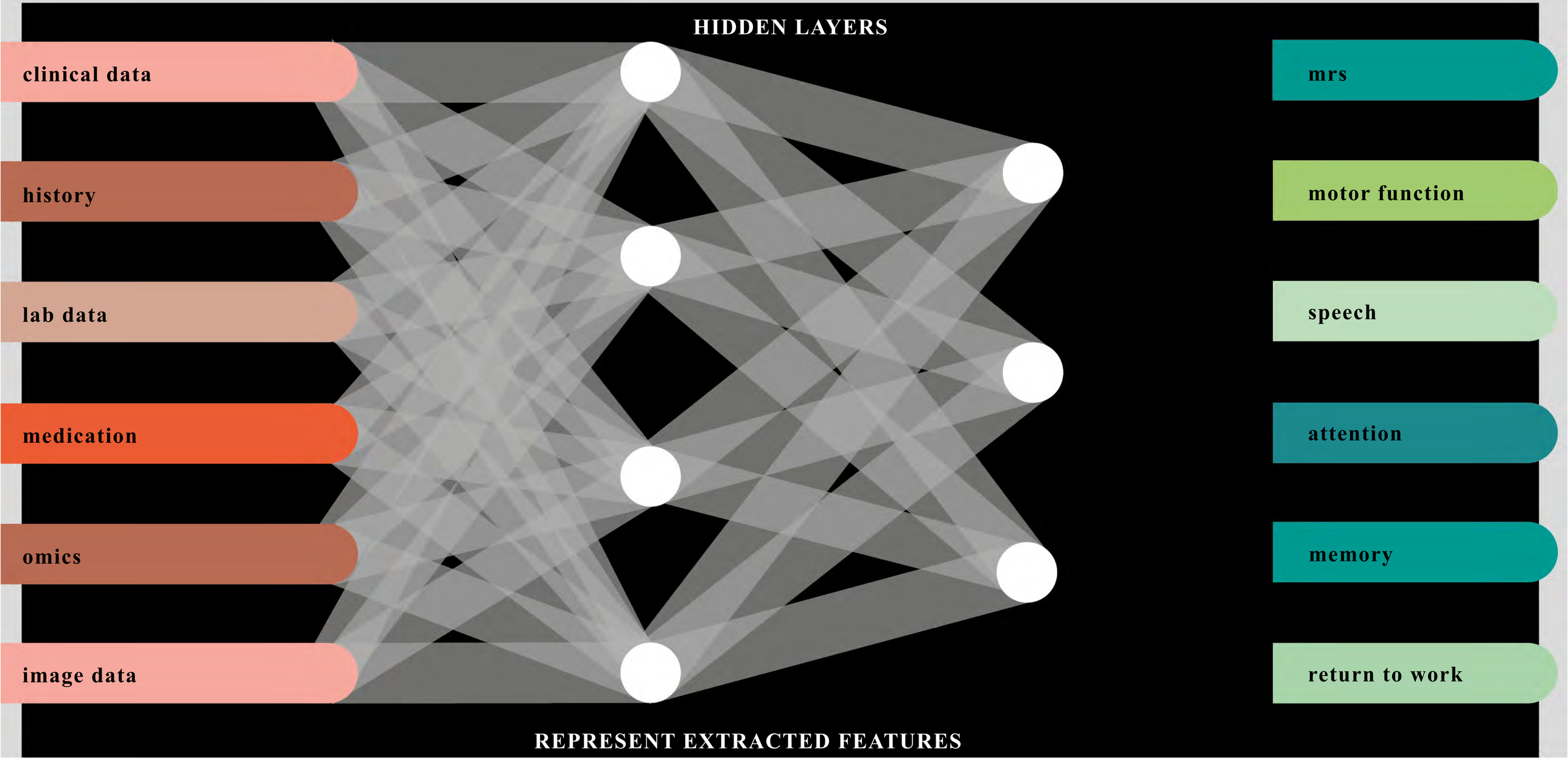
How does this work?



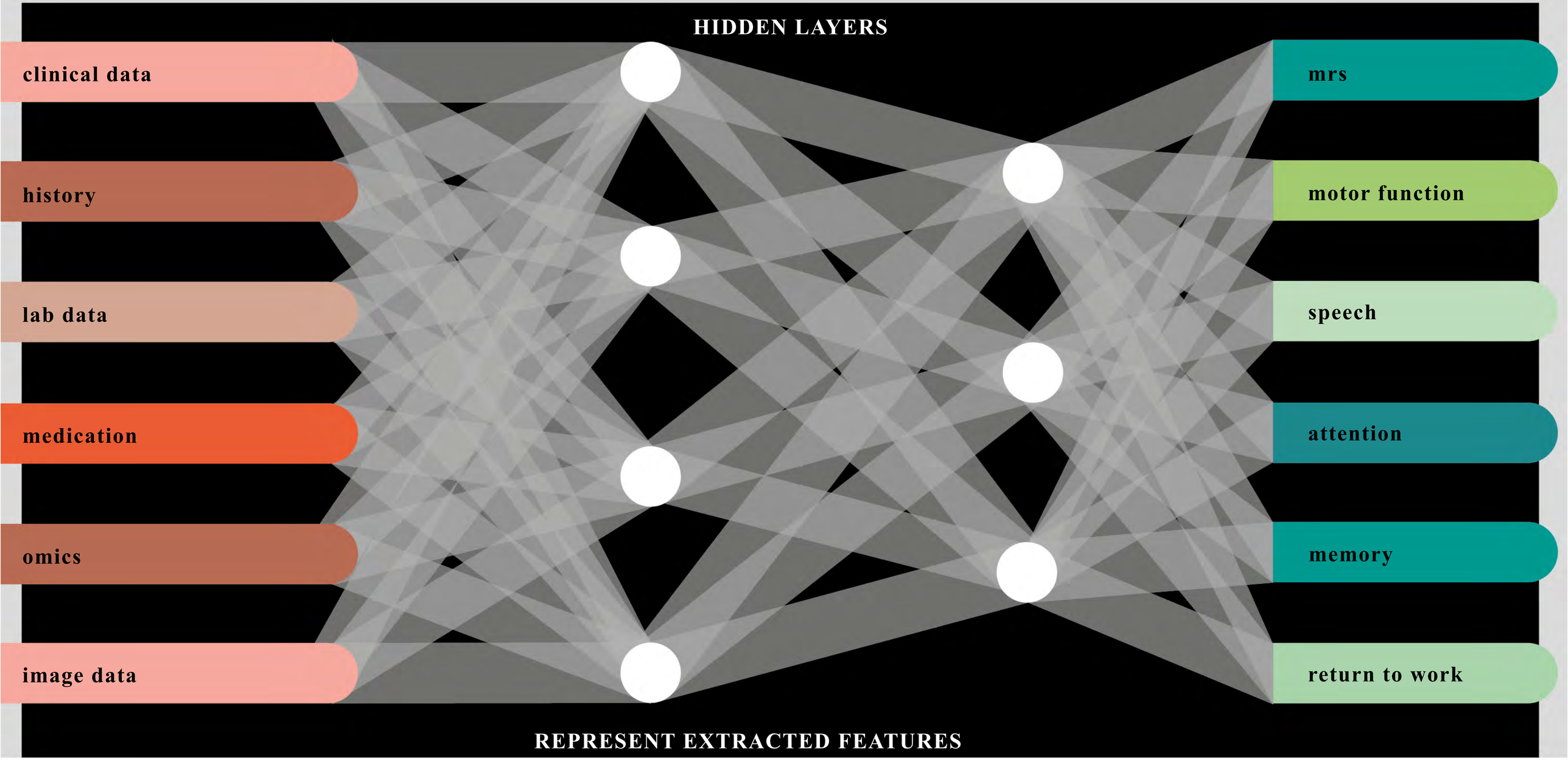
How does this work?



How does this work?



How does this work?



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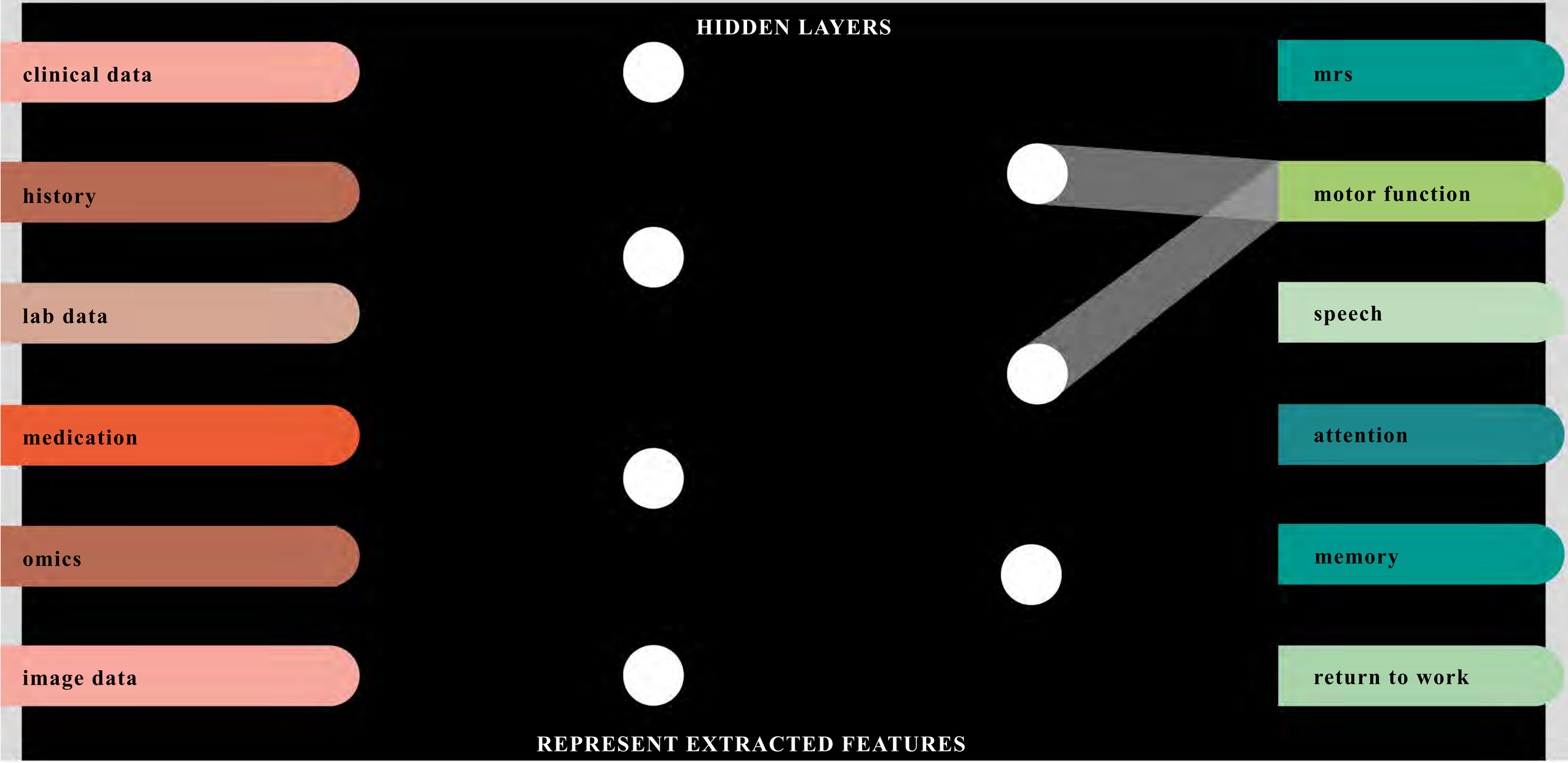

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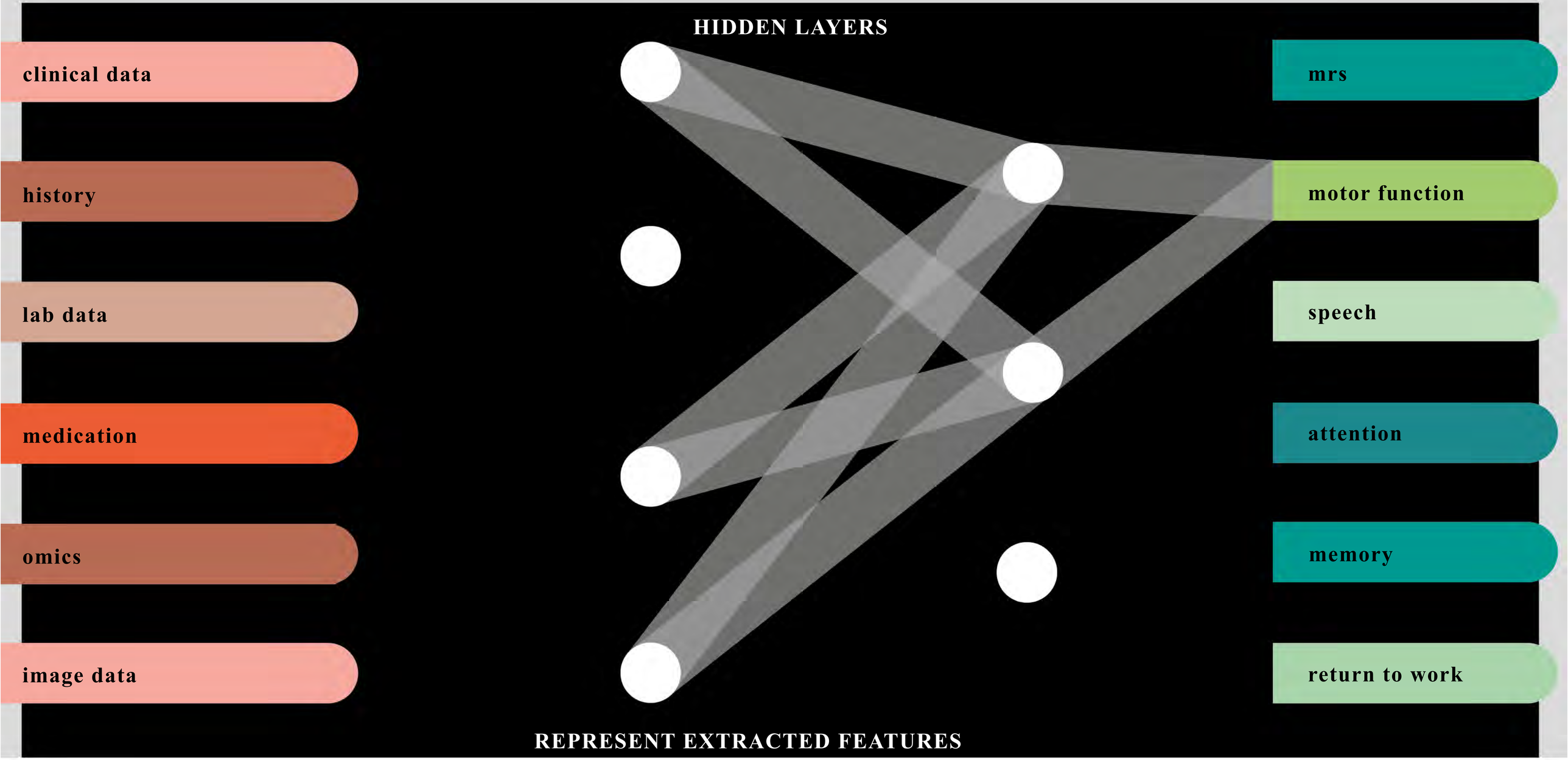

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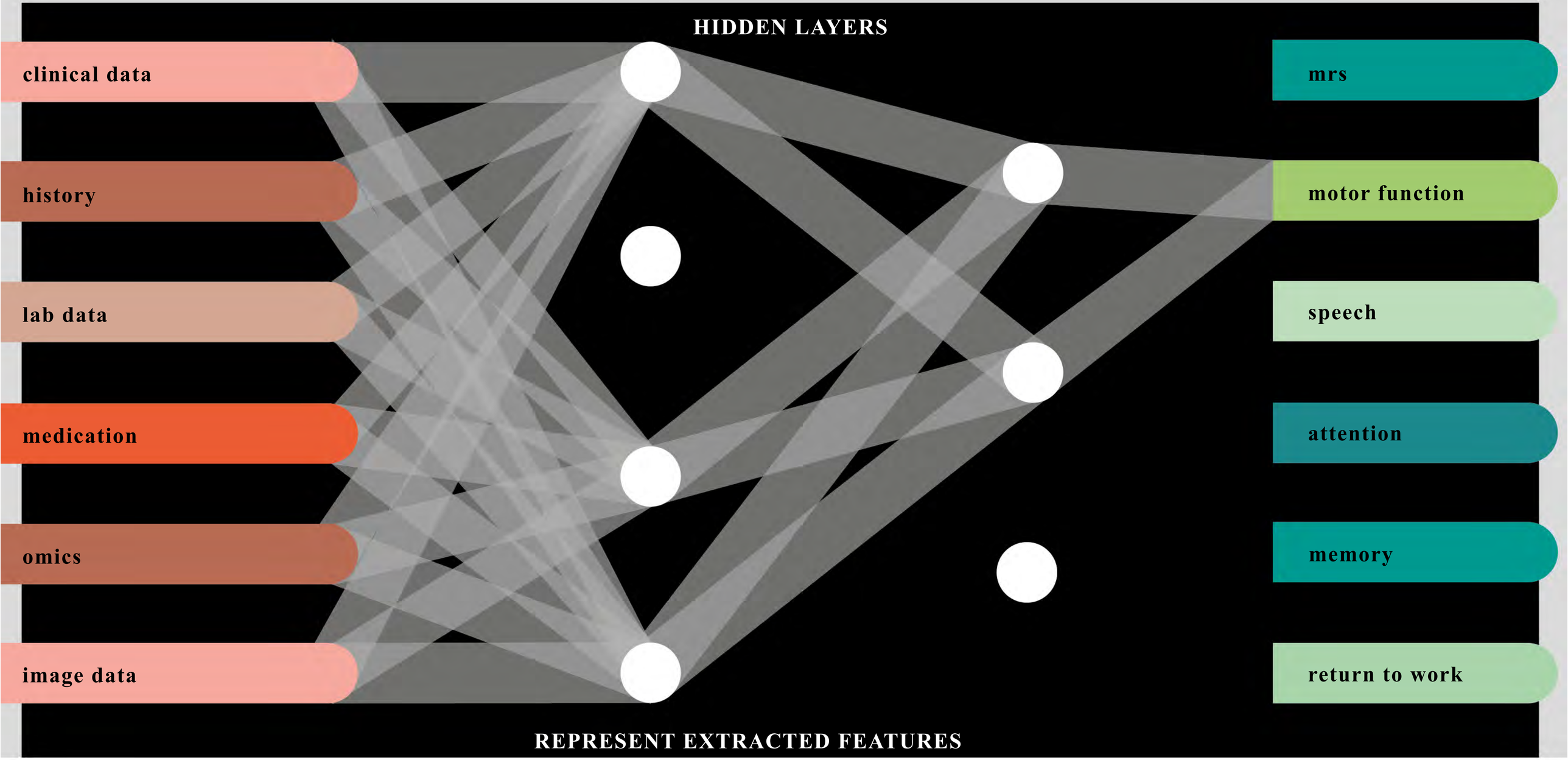
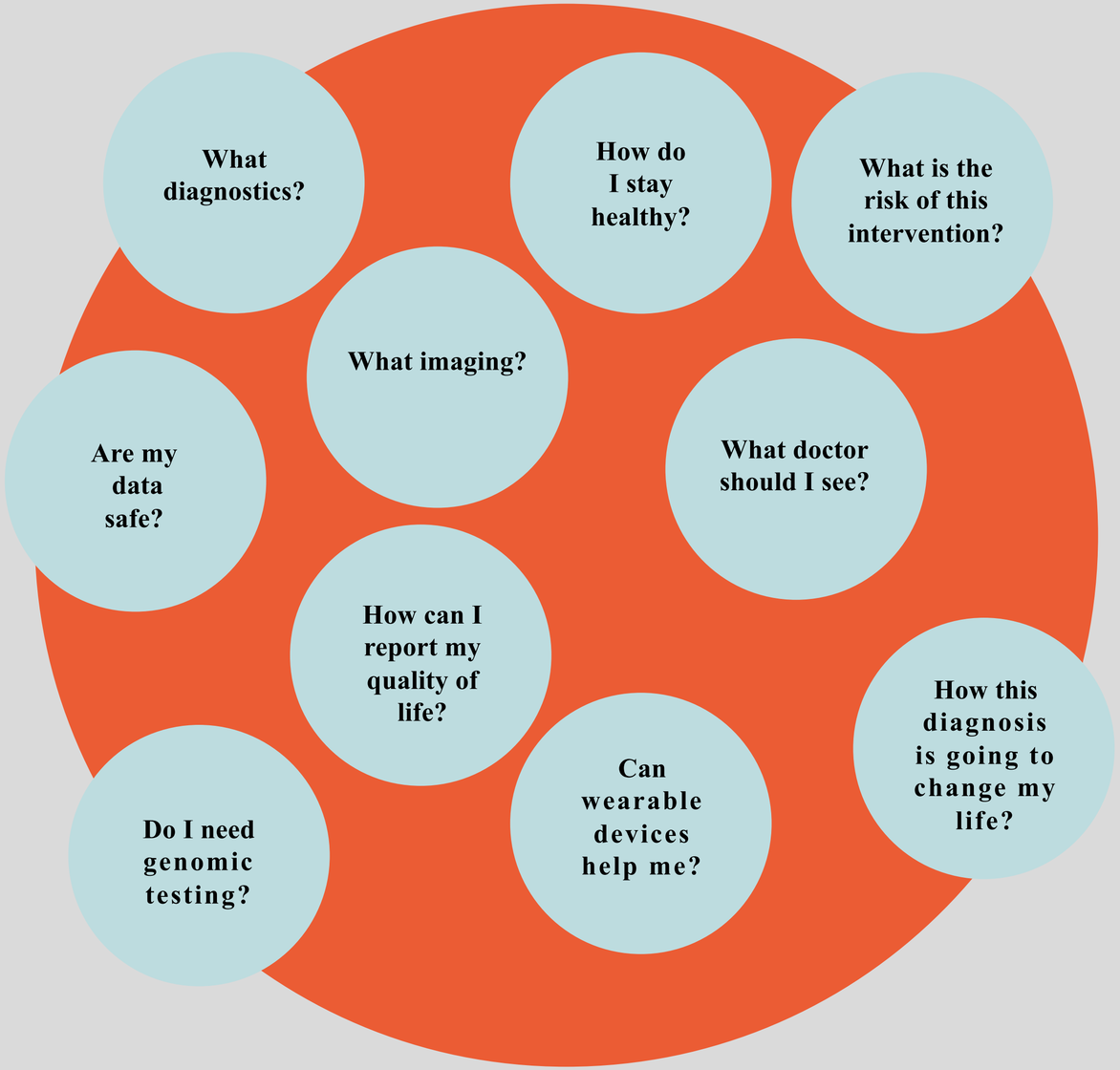


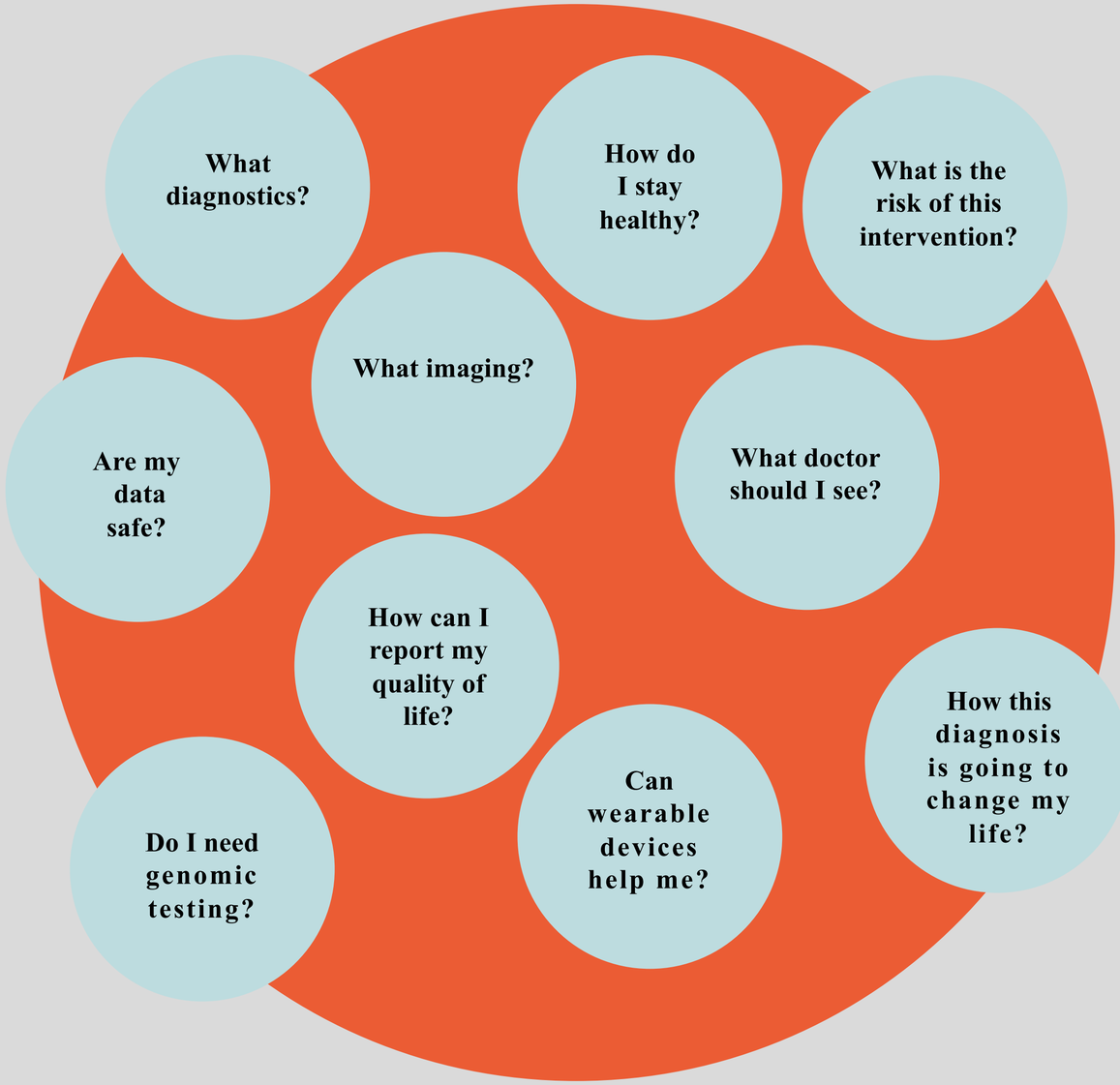
To do

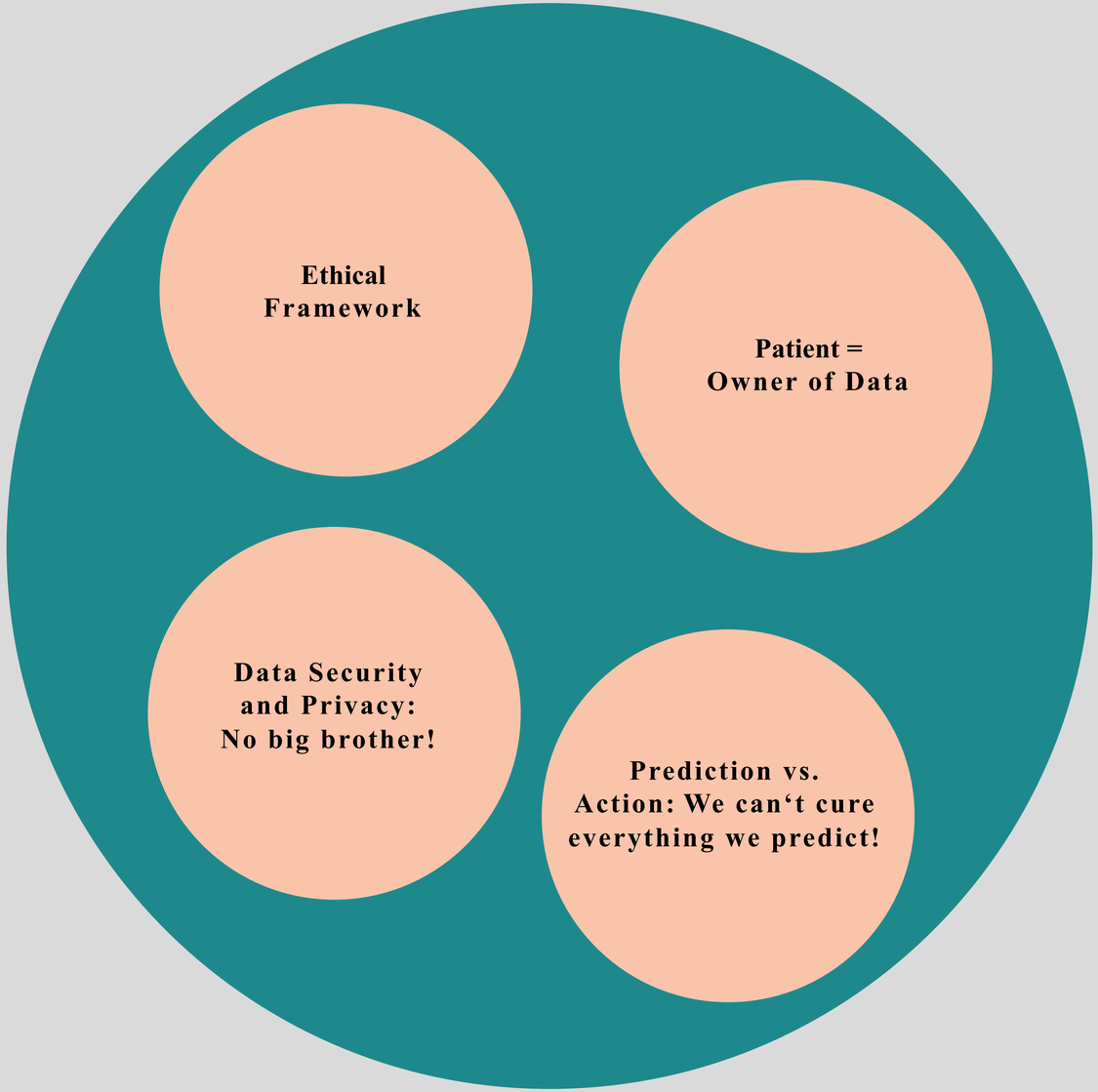
Questions from the patient



To do

Our answers





Let‘s take a deep breath!

Neglected data → Maximum information

Clinic-based → Patient-centric

Generalized guidelines → Personalized treatment

Problem

1,2m strokes per year in Europe

Stroke is the second leading cause of death worldwide.

Over 60% of stroke survivors suffer from permanent restrictions in their daily activities.

€11,5 billion per year direct medical costs

The direct medical treatment cost per person affected in Germany amounts to an average of €43,000.

This results in annual costs of € 11.5 billion for the healthcare system.

30m people at risk

In Germany there are around 30m people with an elevated risk for cardiovascular events and stroke.

Continuous disease management for this segment would significantly reduce the medica, financial and social impact of stroke.

Treatment

A hospital solution as a tablet-based App

Best Treatment

4 years development @Charité

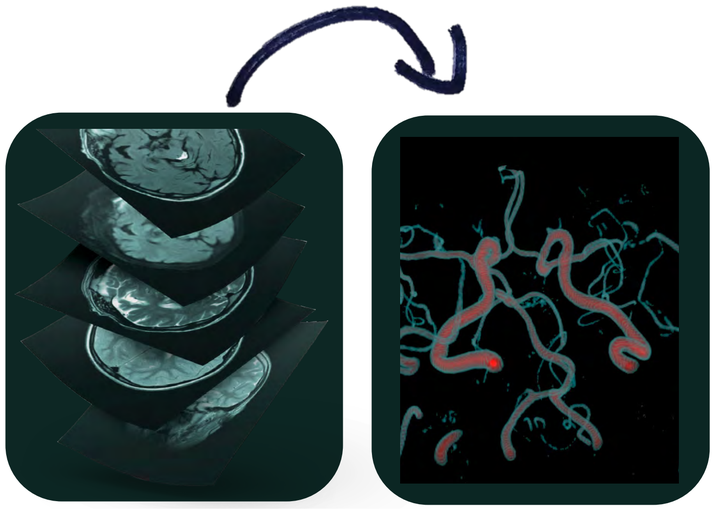
R&D funding by Federal Ministry of Research , Data access, prototype to be deployed

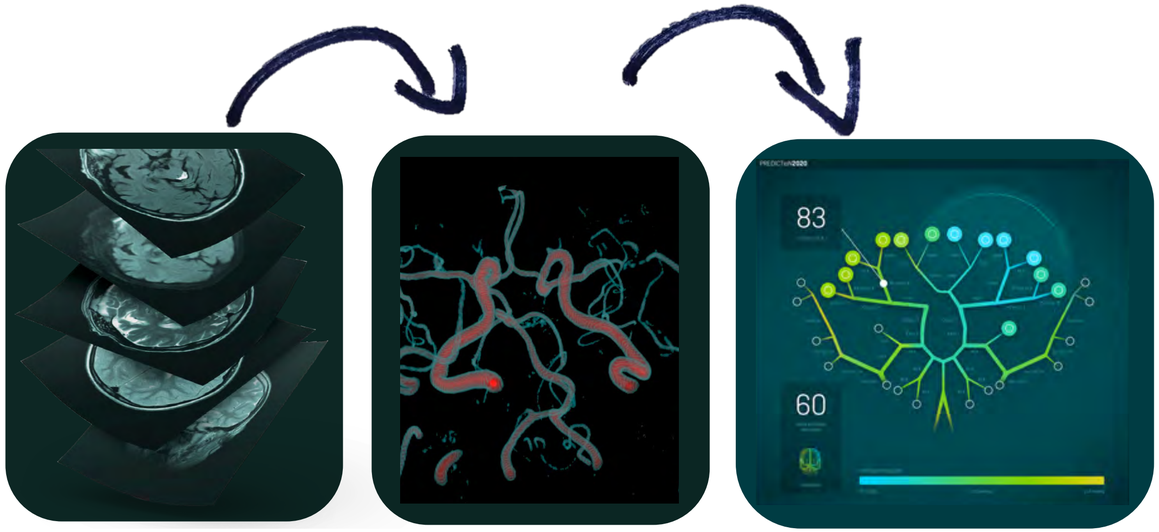
Integrating all available digital data

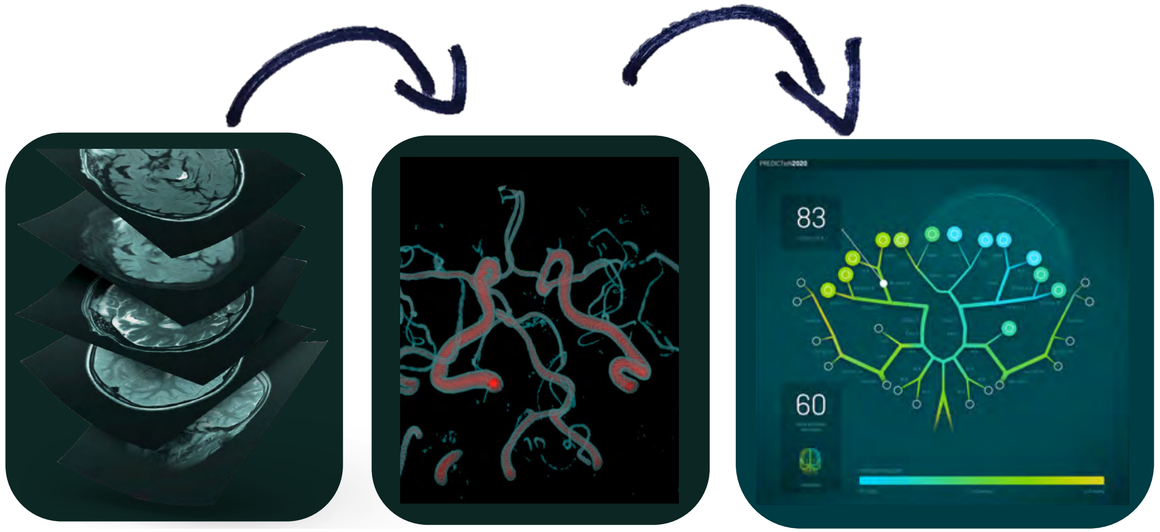
Creating a data-driven clinical decision support system

Outcome prediction based on hybrid models

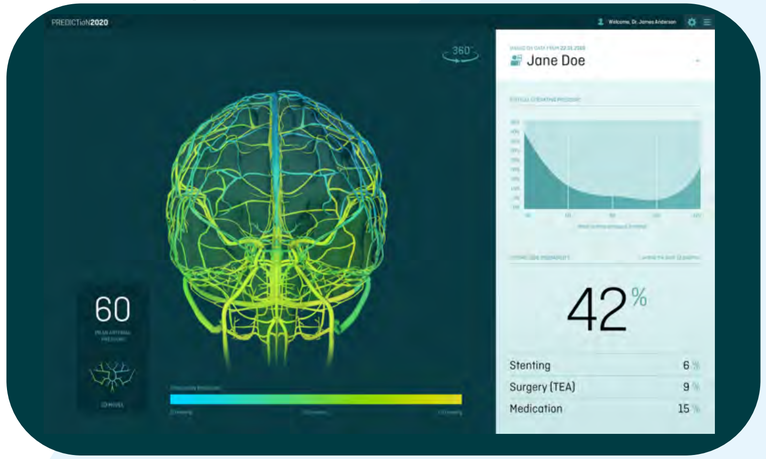
Cutting-edge machine learning and deep learning technologies

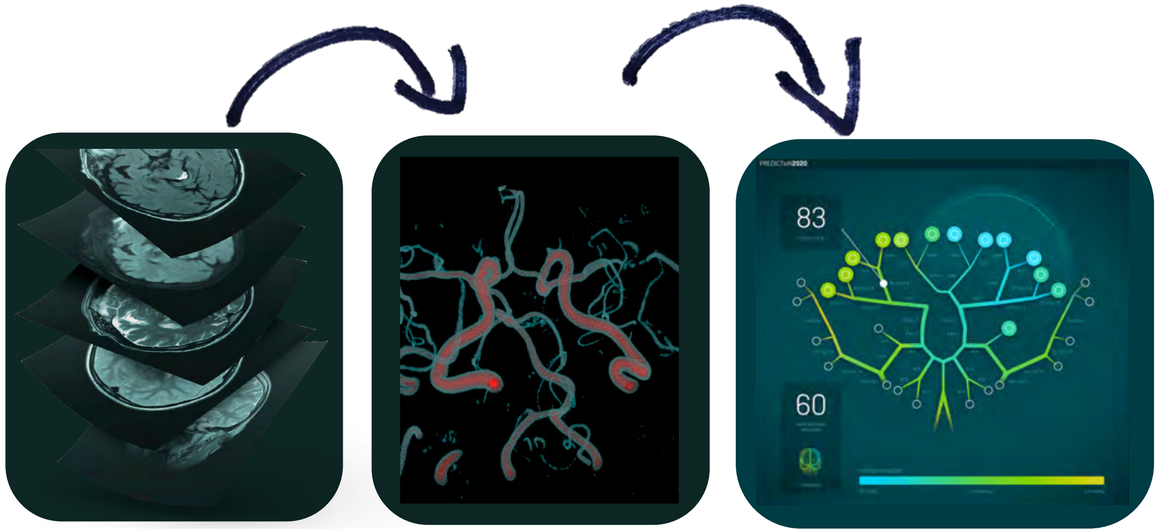



83
60


83
60

Simulation


PREDICTeR2020
Jane Doe
60
42%
Stenting 6%
Surgery (TEA) 9%
Medication 15%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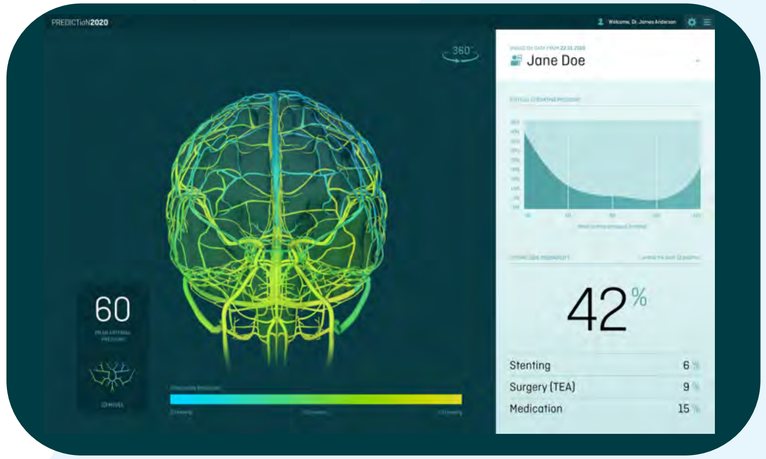
Simulation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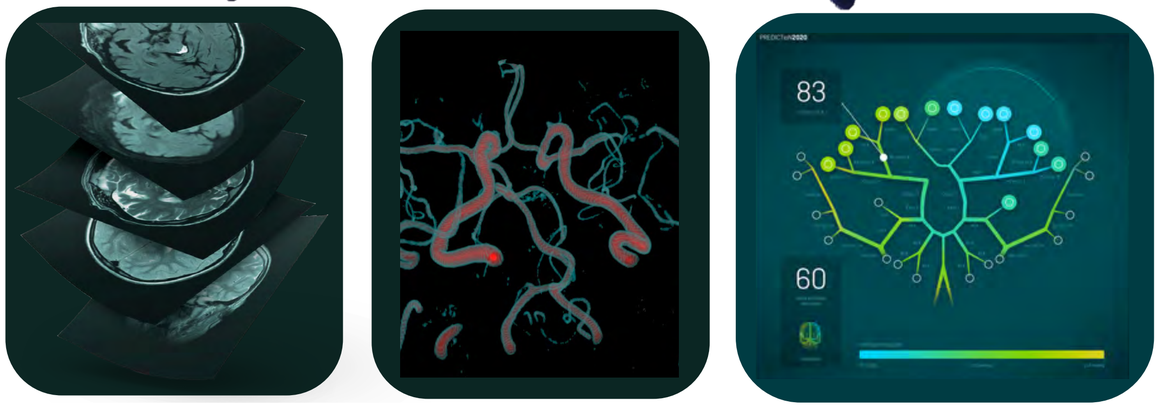
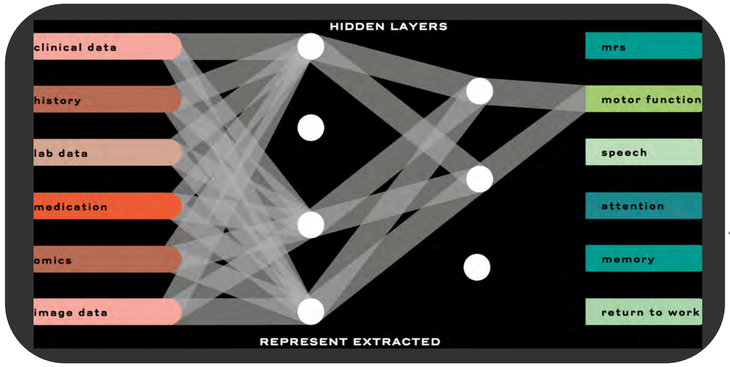


simulation

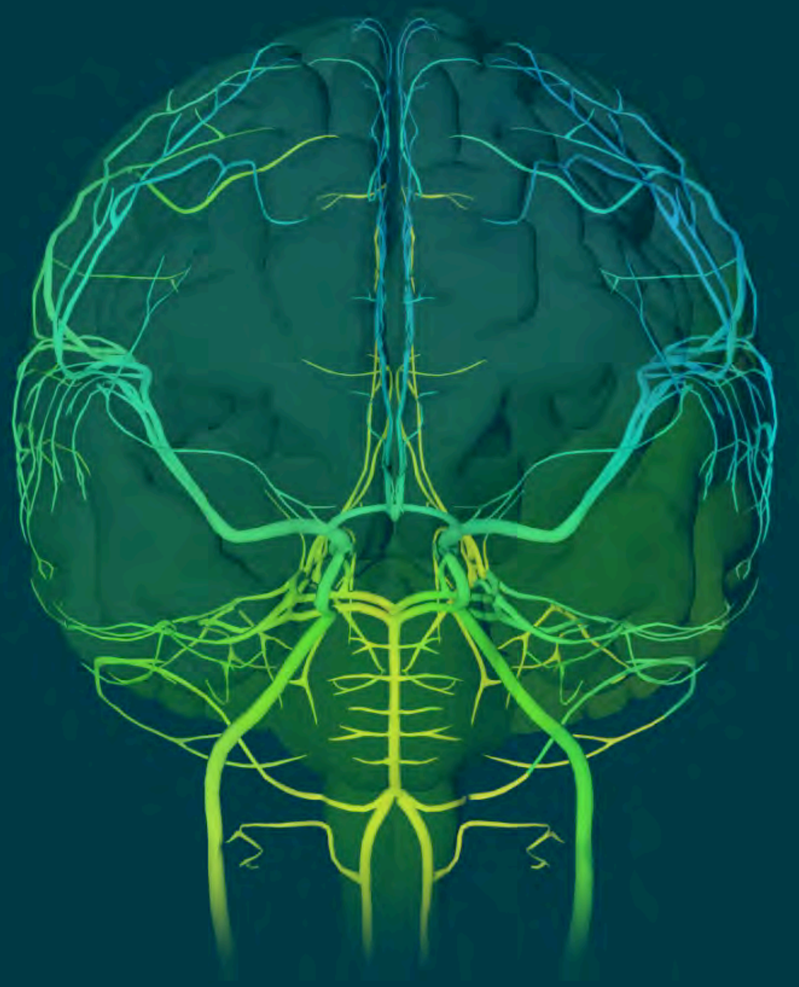


machine learning

PREDICTioN**2020**

Welcome, Dr. James Anderson

360°



60

MEAN ARTERIAL PRESSURE

2D MODEL

PERFUSION PRESSURE

50 mmHg | 100 mmHg | 150 mmHg

BASED ON DATA FROM **22.01.2018**

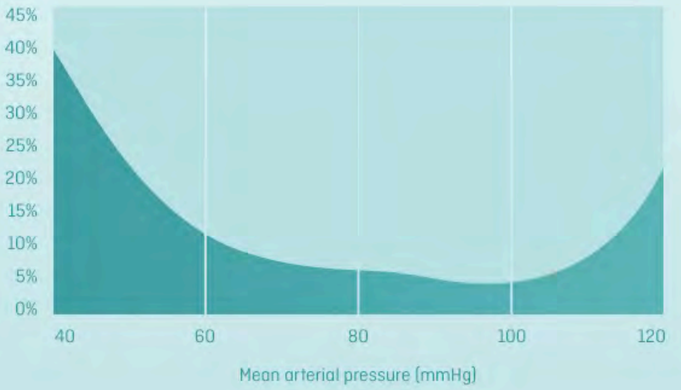
Jane Doe

STROKE RISK PROBABILITY — within the nest 12 months

42 %

Stenting	6 %
Surgery (TEA)	9 %
Medication	15 %

CRITICAL OPERATING PRESSURE



The P2020 Best Treatment aims to provide an easy-to-use, seamlessly integrated and AI-based clinical decision support system to provide best treatment for acute stroke patients.

Provides individual risk

Allows for best acute treatment selection

Yields best outcome on a personalized level

Another breath!

PRECISE4Q

PREDICTIVE MODELLING IN STROKE

PRECISE4Q – Leading academic research in Europe (H2020)

CHARITÉ UNIVERSITÄTSMEDIZIN BERLIN

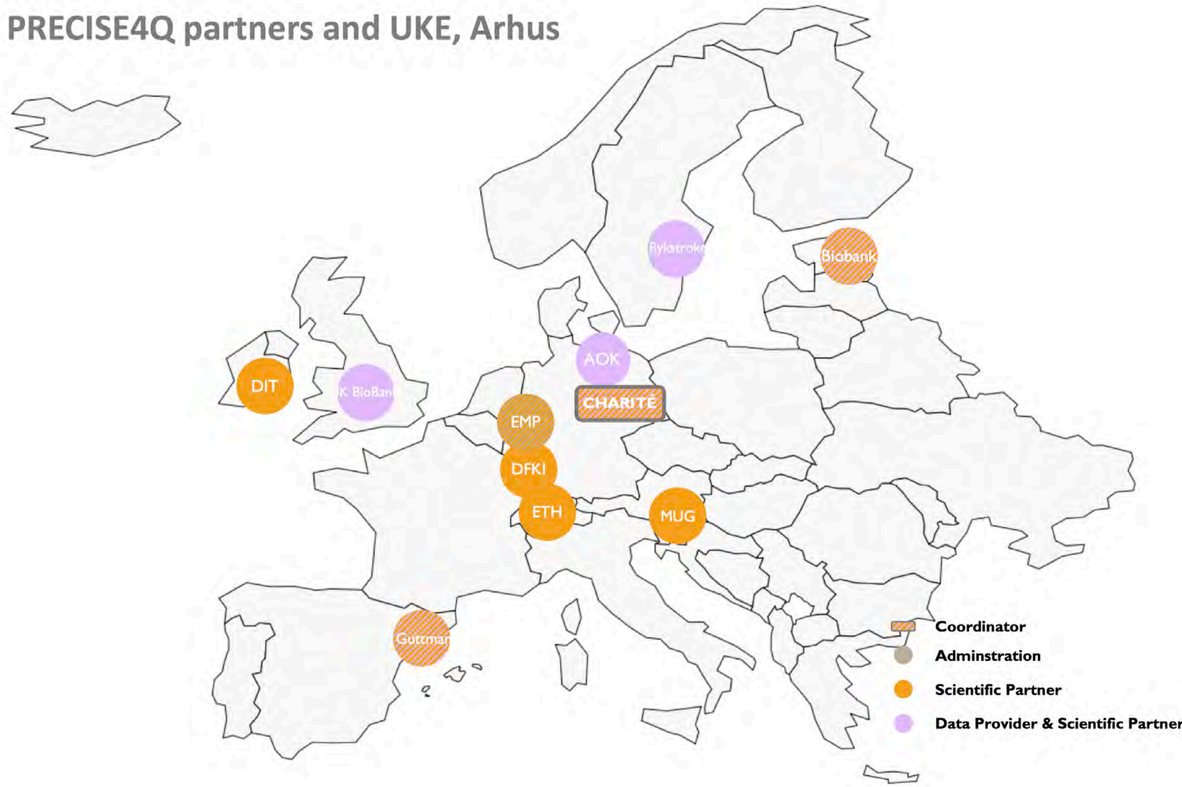
Dietmar Frey, MD JD MBA

Leading Europe: PRECISE4Q

PRECISE4Q
PREDICTIVE MODELLING IN STROKE

- **11 partners, €6m 4 years (2018-2022)**
- **Led by Charité**
- **Largest stroke data collection**

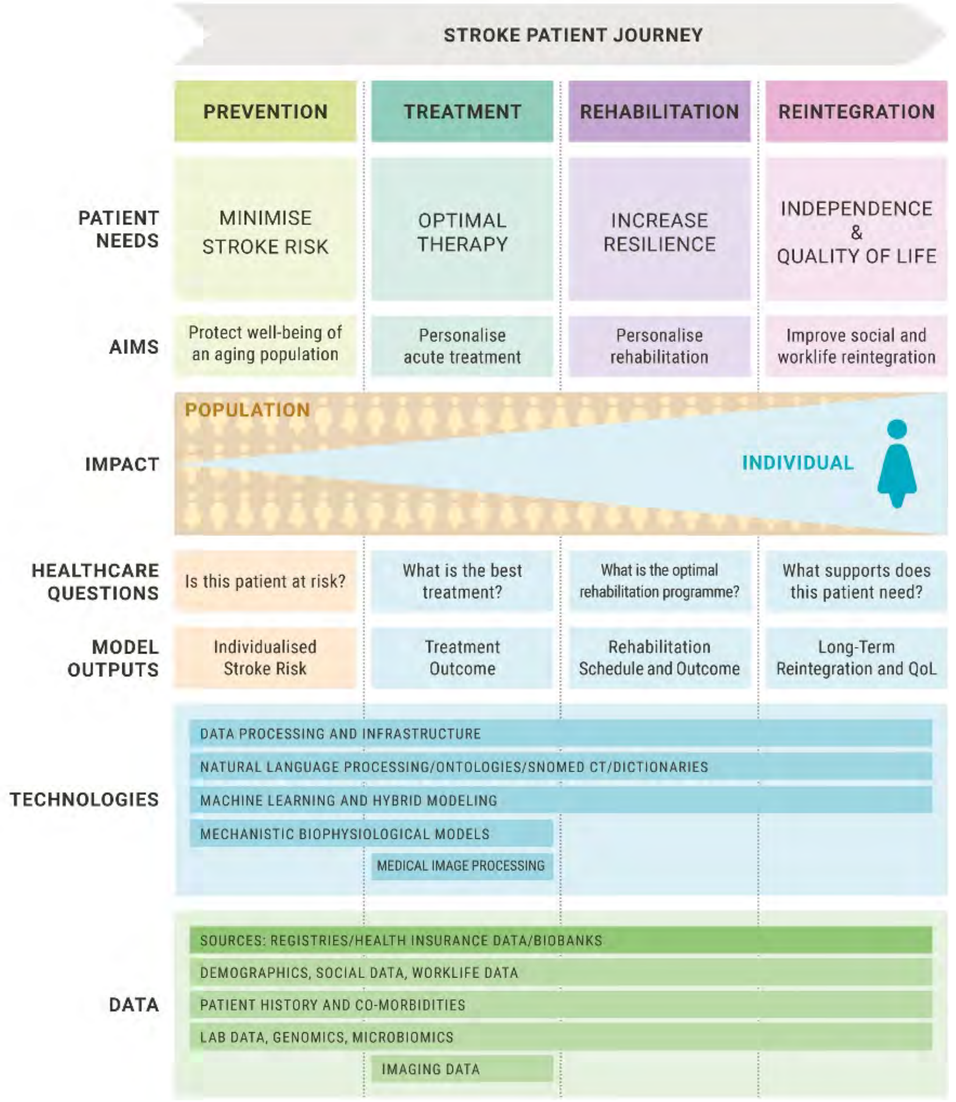
➢ **Building models for each phase**

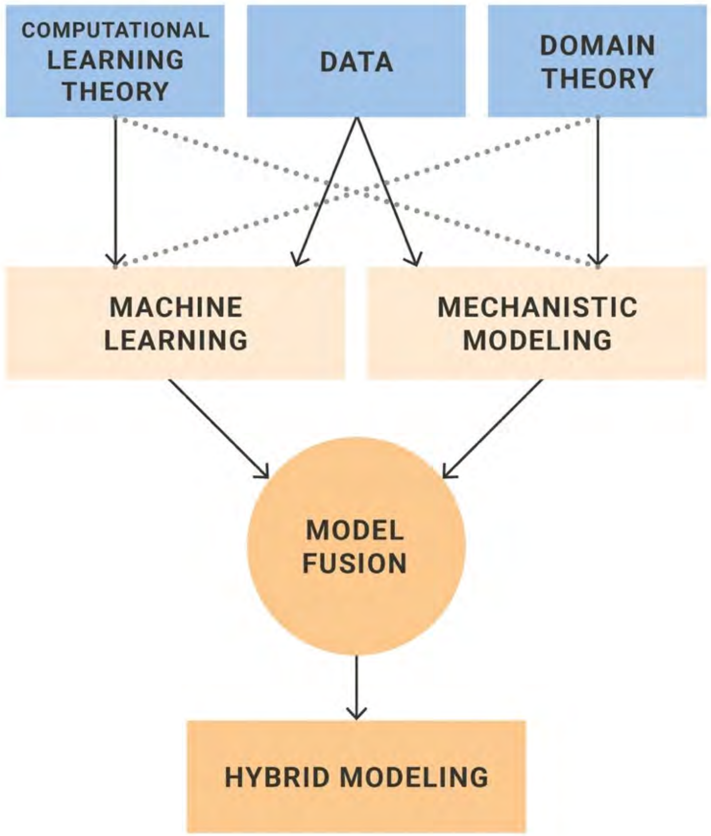


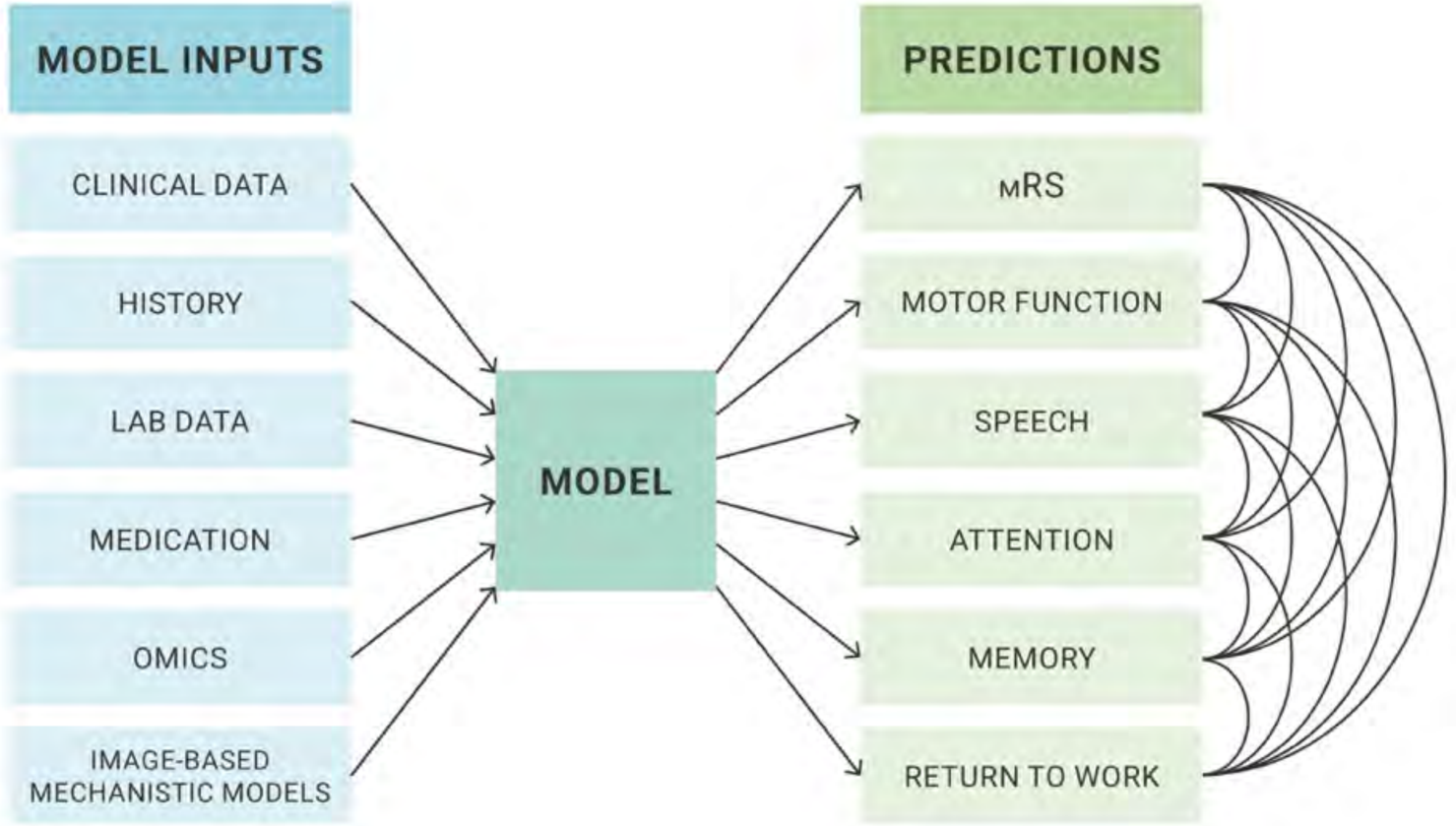
https://www.charite.de/service/pressemitteilung/artikel/detail/personalisierte_und_optimierte_versorgung_von_schlaganfallpatienten/

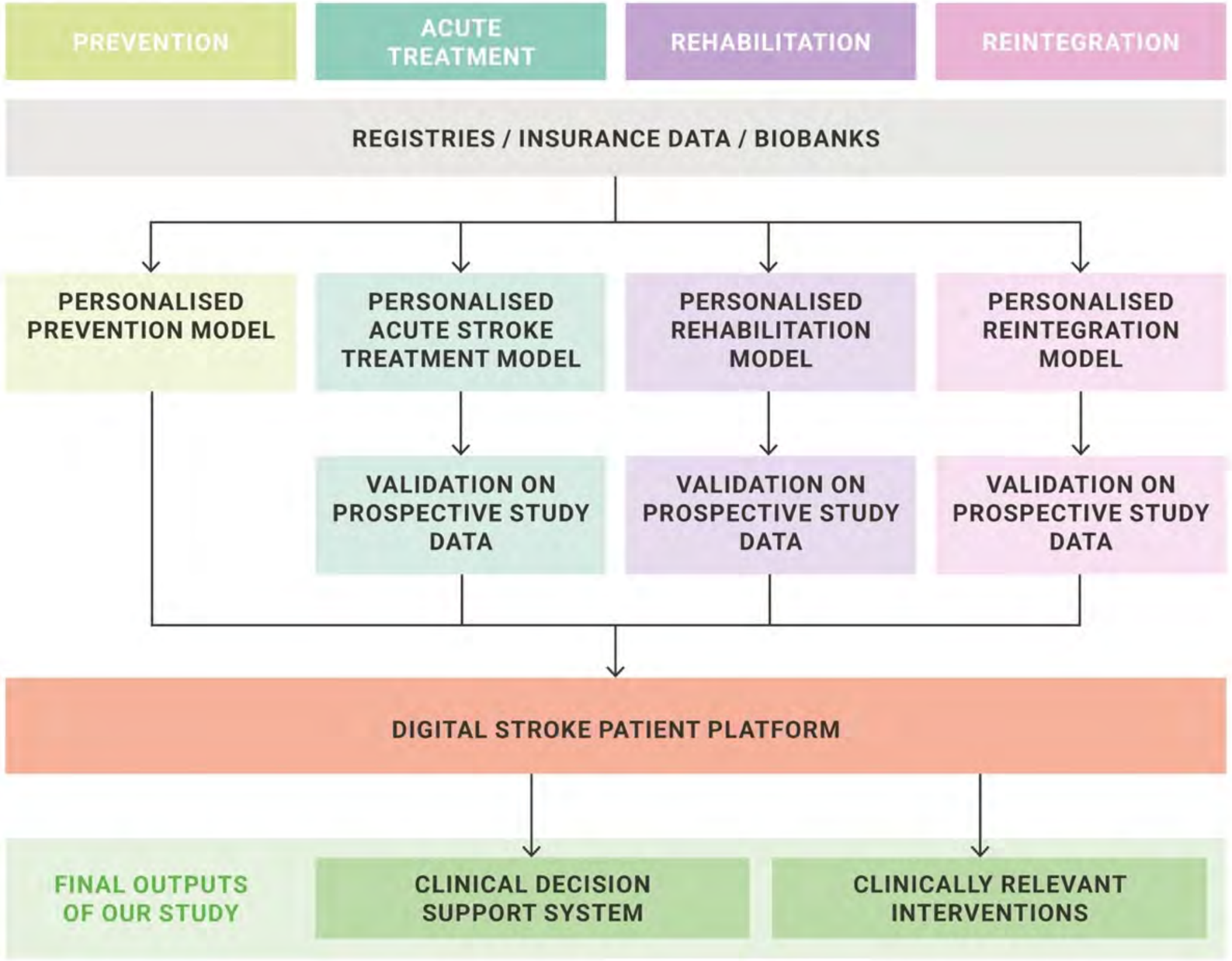
Creating a data-driven AI-based decision support system for personalized

1. Prevention,
2. Treatment,
3. Rehabilitation, and
4. Reintegration




COMPUTATIONAL LEARNING THEORY
DATA
DOMAIN THEORY
MACHINE LEARNING
MECHANISTIC MODELING
MODEL FUSION
HYBRID MODELING


MODEL INPUTS
CLINICAL DATA
HISTORY
LAB DATA
MEDICATION
OMICS
IMAGE-BASED MECHANISTIC MODELS
MODEL
PREDICTIONS
mRS
MOTOR FUNCTION
SPEECH
ATTENTION
MEMORY
RETURN TO WORK

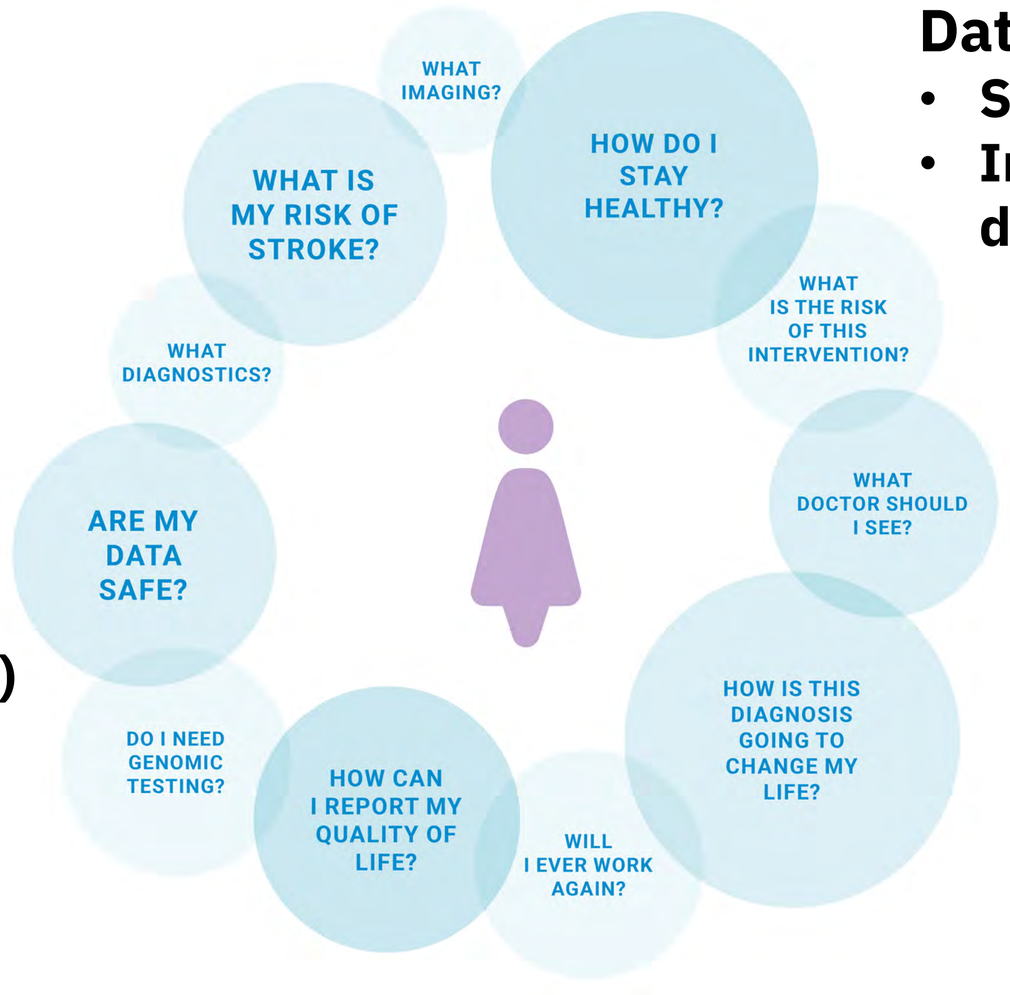

PREVENTION
ACUTE TREATMENT
REHABILITATION
REINTEGRATION
REGISTRIES / INSURANCE DATA / BIOBANKS
PERSONALISED PREVENTION MODEL
PERSONALISED ACUTE STROKE TREATMENT MODEL
PERSONALISED REHABILITATION MODEL
PERSONALISED REINTEGRATION MODEL
VALIDATION ON PROSPECTIVE STUDY DATA
VALIDATION ON PROSPECTIVE STUDY DATA
VALIDATION ON PROSPECTIVE STUDY DATA
DIGITAL STROKE PATIENT PLATFORM
FINAL OUTPUTS OF OUR STUDY
CLINICAL DECISION SUPPORT SYSTEM
CLINICALLY RELEVANT INTERVENTIONS

Medical

- Benefit for individual
- Health-economic benefit

Ethical

- Bias (test/training)
- ML conflicts
- Patient autonomy



Data

- Safety & security (GDPR)
- Infrastructure (centralized vs. decentralized)

Modeling

- Data access
- Few data (e.g. thrombectomy)

Roll out

- Few incentives for prevention
- Regulation (MDR)

The perspective

VALIDATE ENABLES IMPLEMENTATION INTO CLINICAL PRACTICE

VALIDATION

PRE-CLINICAL EVIDENCE *

AGILE AI MODEL REFINEMENT

HIS INTEGRATION, UX/UI, SAFETY

Clinical data | Medi-cation

Imaging data | OMICS data

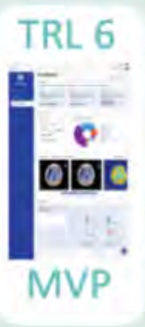
Lab data | etc.

PRE-EXISTING AI-BASED MODELS*

TRUSTWORTHY AI

NEEDS OF PATIENTS AND HEALTHCARE PROFESSIONALS

QUALITY OF LIFE (DALY)



CLINICAL VALIDATION

REGULATORY VALIDATION

BUSINESS VALIDATION

AI-based PoC ("Bench")

VALIDATE SHOWS PATHWAY FOR INTEGRATION OF AI IN HEALTHCARE (SOPs)

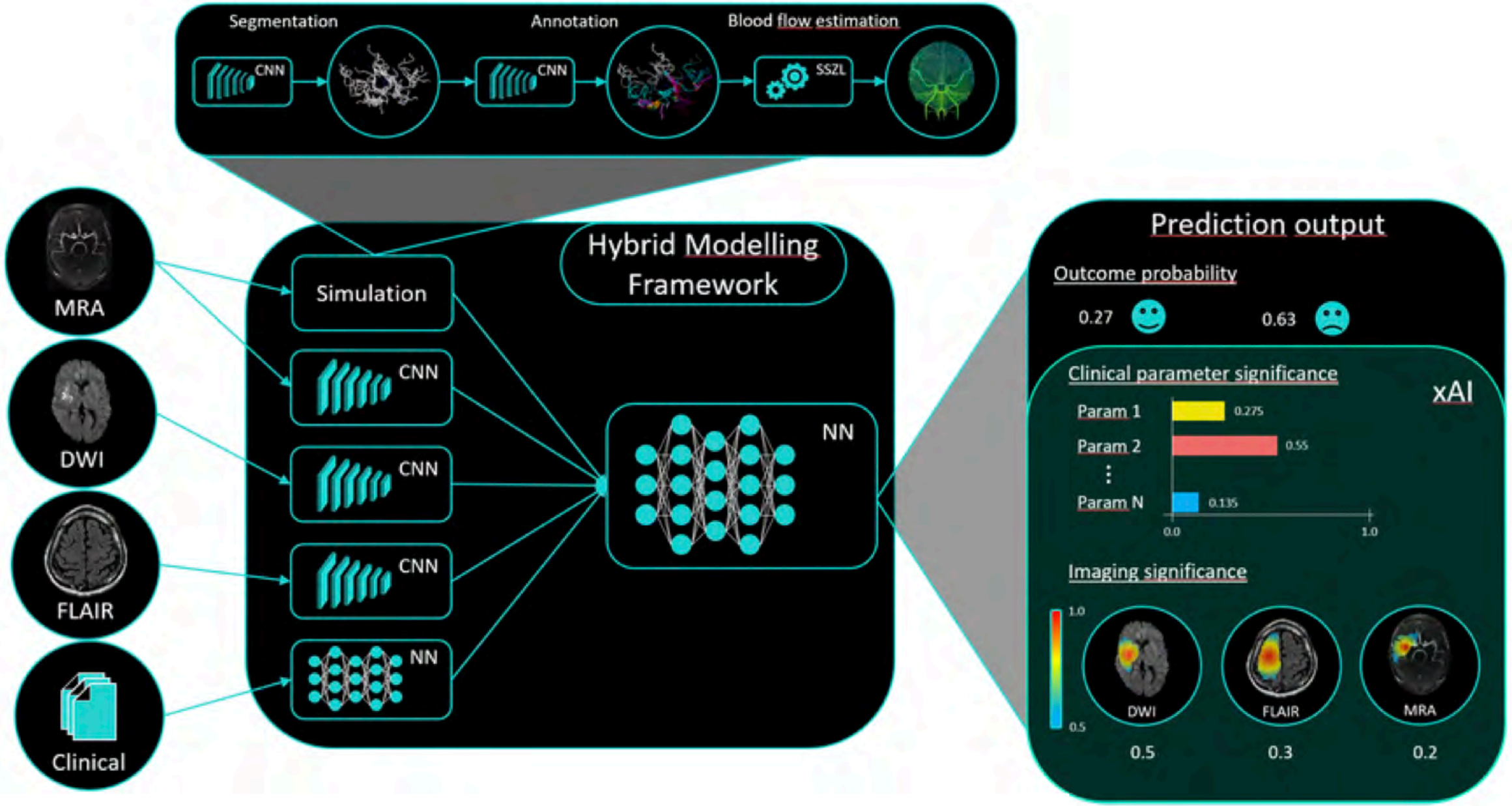
Prognostic Tool ("Bedside")

* BASED ON EXISTING RESEARCH AND PUBLICATIONS BY THE CONSORTIUM

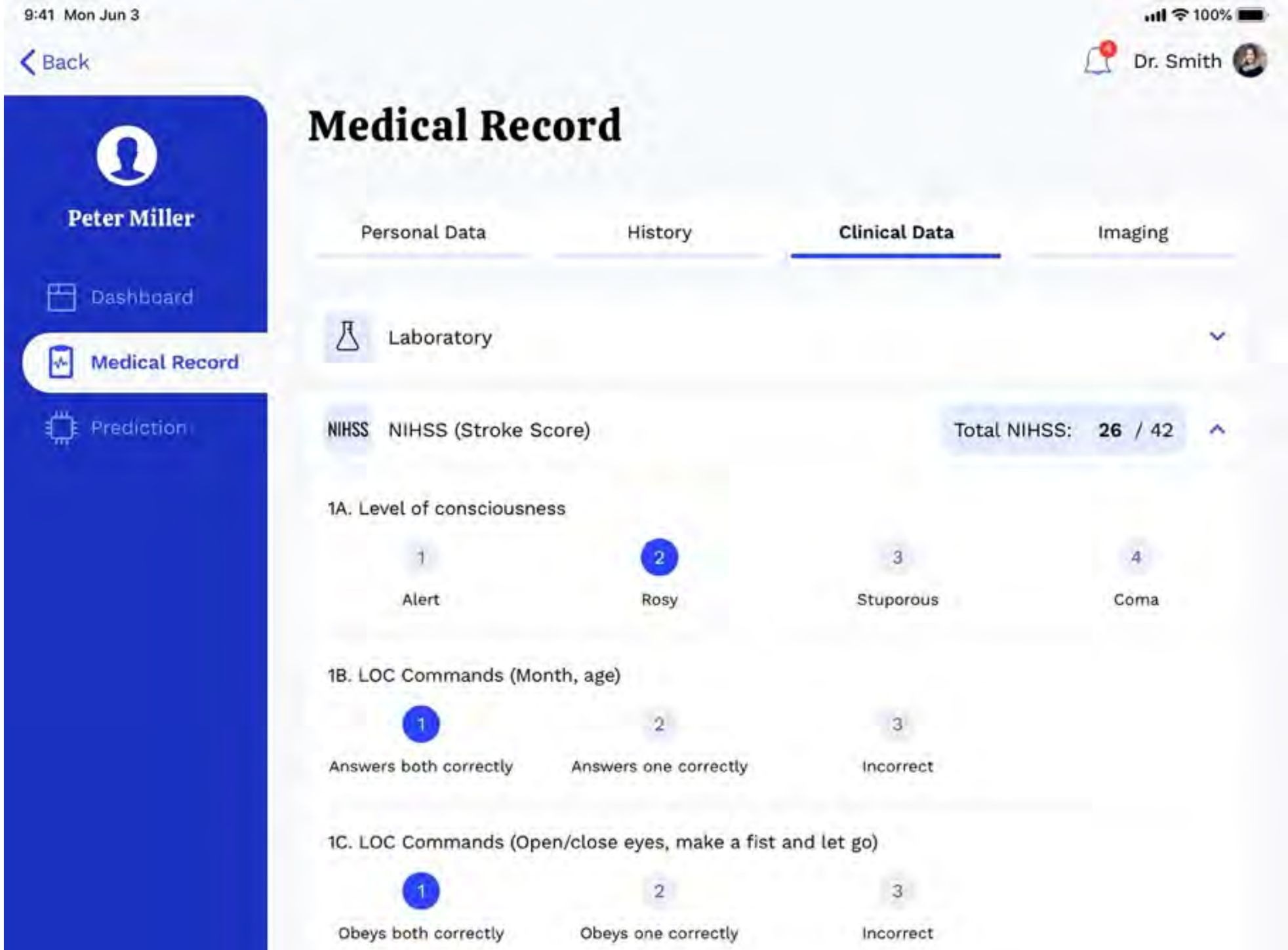
VALIDATE – HORIZON EUROPE

	Coordination	Trustworthy AI	AI models	Software and Integration	Clinical site	Industry	Patient engagement	Health economics
Charité Universitätsmedizin Berlin	●	●	●	○	○	○	○	●
Empirica GmbH	●	○	○	○	○	●	○	●
Technological University Dublin	○	●	●	○	○	○	○	○
Simula Digital Engineering Oslo	○	●	○	○	○	○	○	○
Universitätsklinikum Heidelberg	○	○	●	○	●	○	●	○
Hadassah Medical Center	○	○	○	○	●	○	●	○
Vall d'Hebron Hospital Barcelona	●	○	○	○	●	○	●	○
IBM iX	○	○	○	●	○	●	●	●
SAFE Stroke Alliance for Europe	○	●	○	○	○	○	●	●
NORA SL	○	○	○	●	○	●	●	●

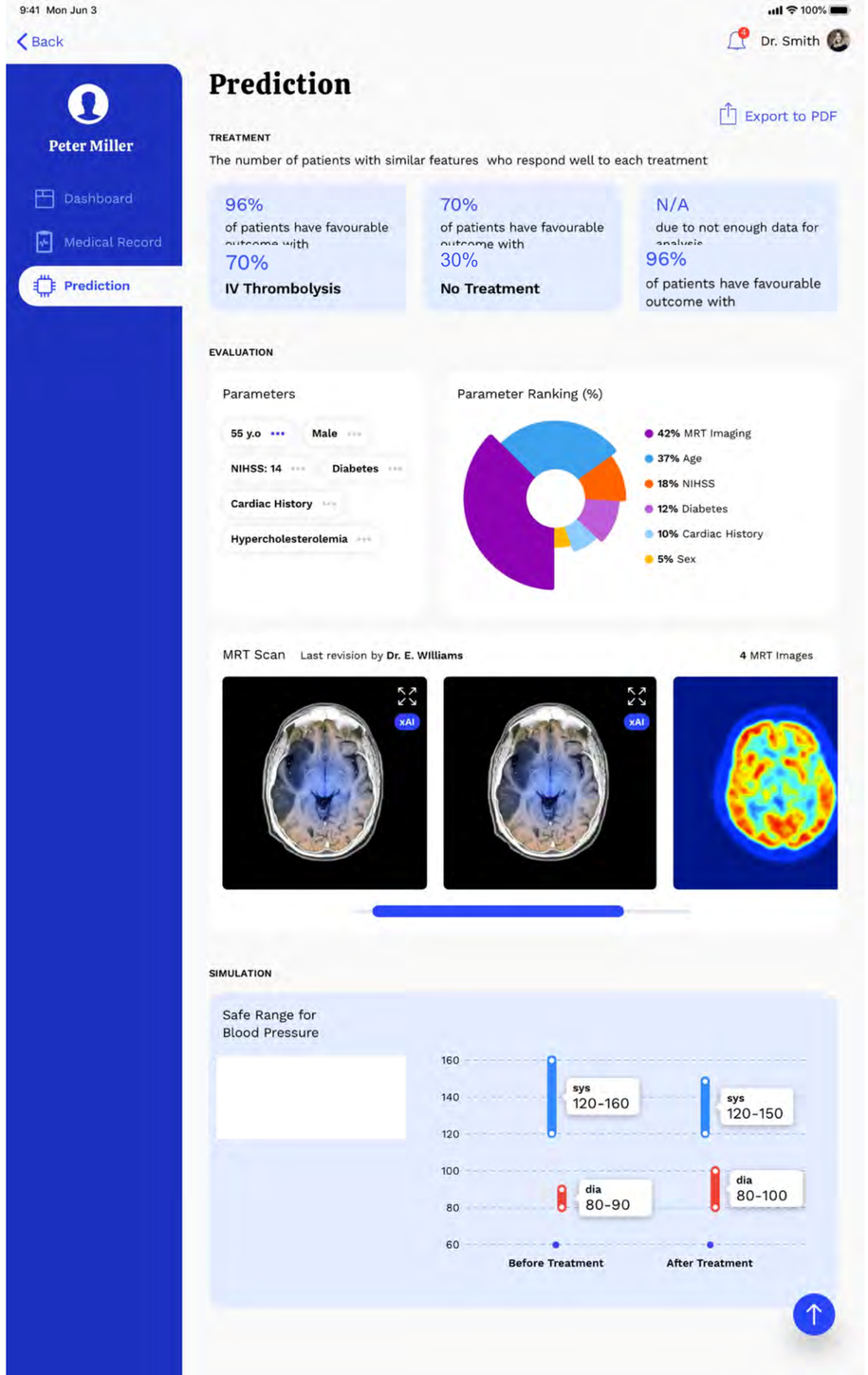
MULTI-STREAM MODEL ARCHITECTURE



MEDICAL RECORD



PREDICTION


9:41 Mon Jun 3
100%
Back
Dr. Smith
Peter Miller
Dashboard
Medical Record
Prediction
Prediction
Export to PDF
TREATMENT
The number of patients with similar features who respond well to each treatment
96%
of patients have favourable outcome with
70%
IV Thrombolysis
70%
of patients have favourable outcome with
30%
No Treatment
N/A
due to not enough data for analysis
96%
of patients have favourable outcome with
EVALUATION
Parameters
55 y.o
Male
NIHSS: 14
Diabetes
Cardiac History
Hypercholesterolemia
Parameter Ranking (%)
42% MRT Imaging
37% Age
18% NIHSS
12% Diabetes
10% Cardiac History
5% Sex
MRT Scan
Last revision by Dr. E. Williams
4 MRT Images
xAI
xAI
SIMULATION
Safe Range for Blood Pressure
160
140
120
100
80
60
sys 120-160
sys 120-150
dia 80-90
dia 80-100
Before Treatment
After Treatment

Vielen Dank!

Dr. med. Dietmar Frey, MD JD MBA
CLAIM Charité Lab for AI in Medicine
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