Sharing images:
The why and how of medical imaging analysis research

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Data stewards course - Health-RI

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University Medical Center Rotterdam

Learning objectives

- Insight into research with medical images

- Understanding how machine learning is crucial in medical imaging research

- Understanding the need for data sharing in image analysis research

- Understanding how Health-RI and data stewards can play an important role here
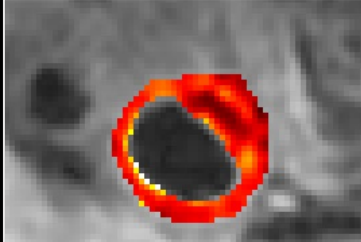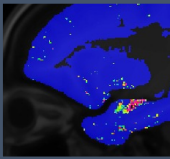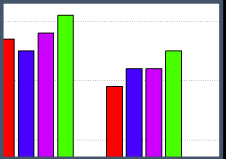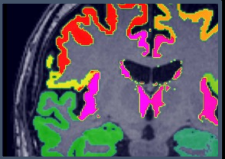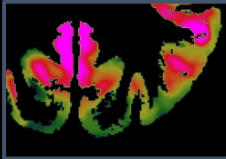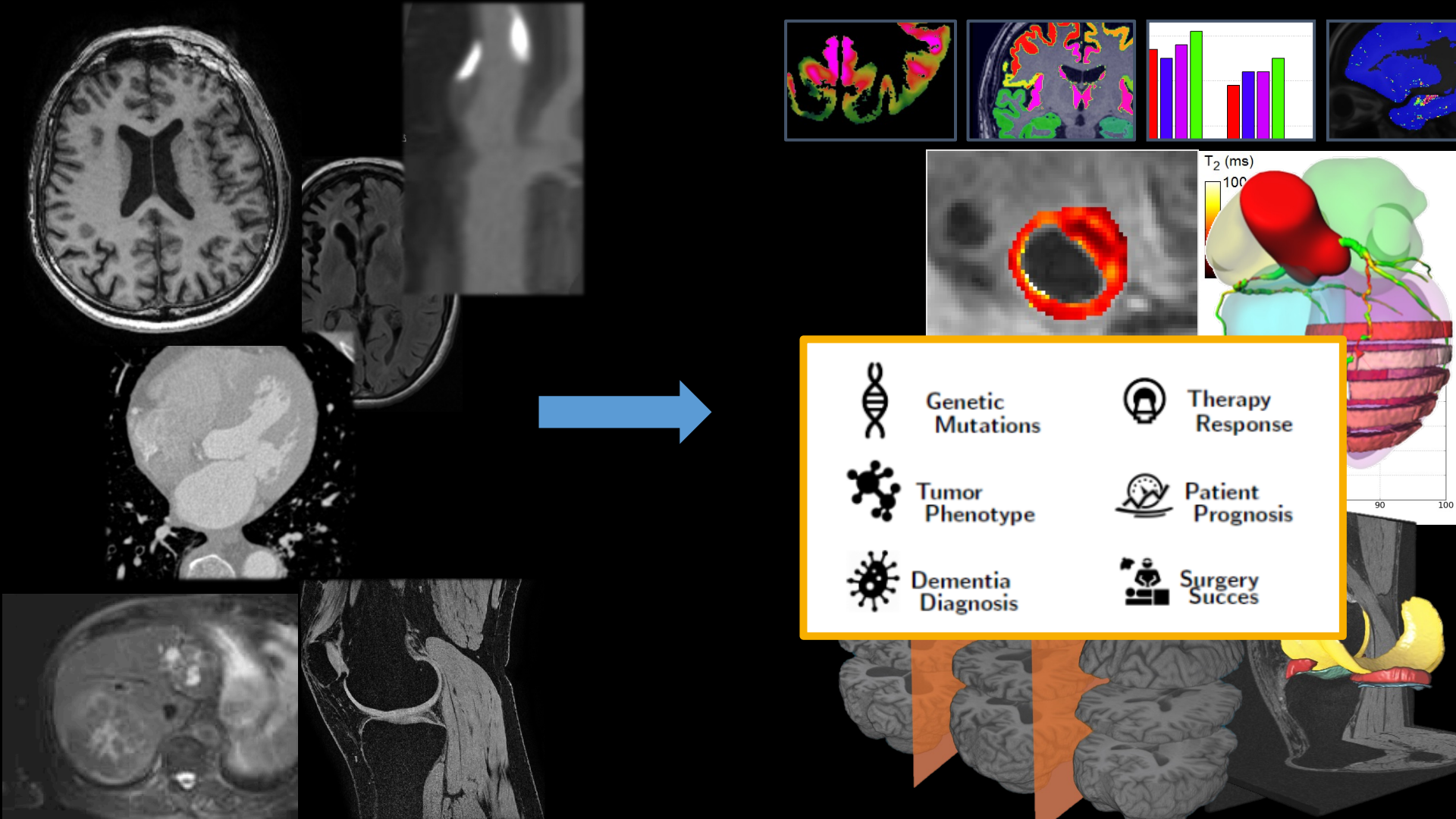
Genetic Mutations

Therapy Response

Tumor Phenotype

Patient Prognosis

Dementia Diagnosis

Surgery Succes

T_2 (ms)
100

90   100

Artificial intelligence
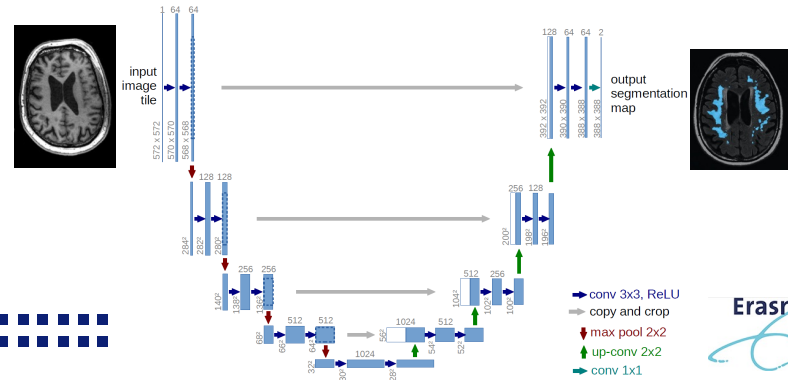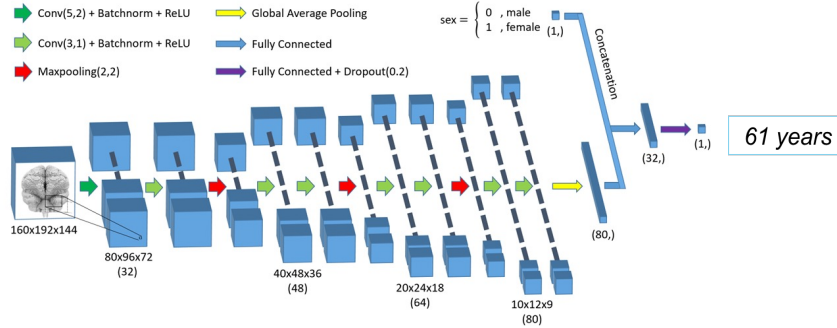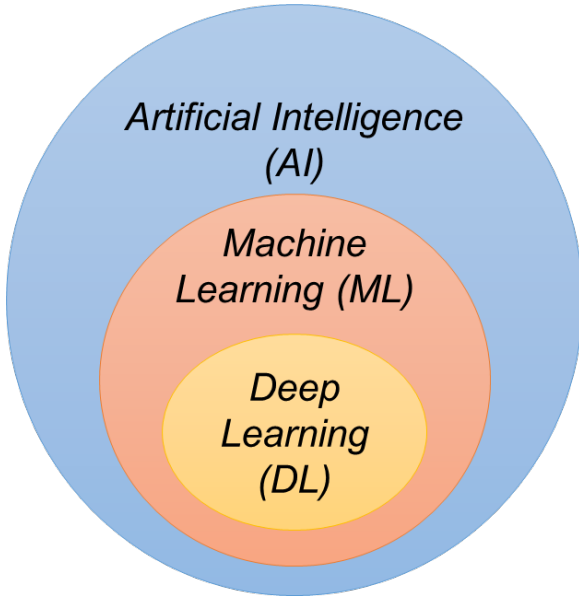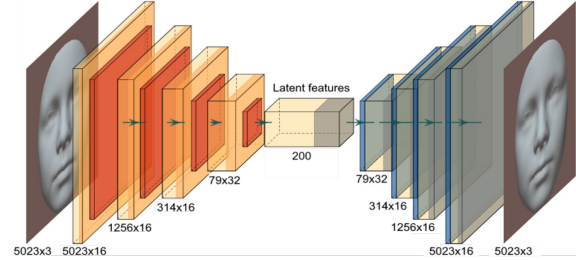
(Supervised) machine learning

Train data

Machine learning model

New data

Model evaluation
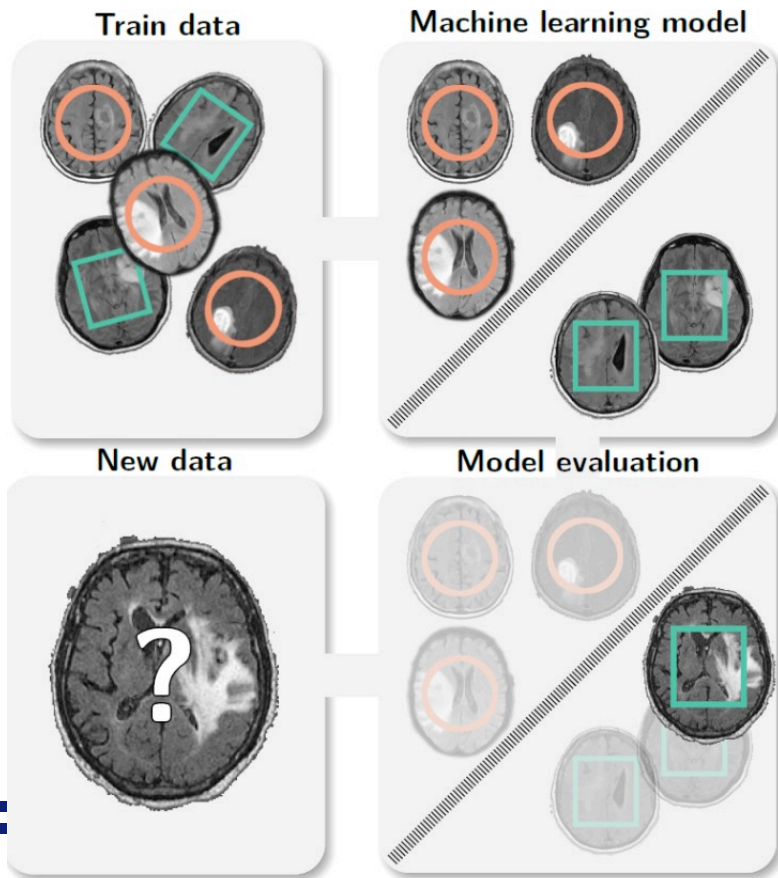
Training data:

Input   Output

1. → □

2. → ○

⋮   ⋮

N. → □
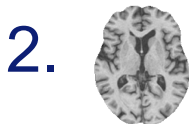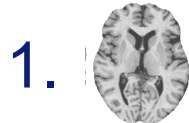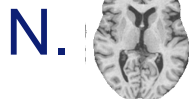
Etiological diagnosis

Alzheimer's disease
Vascular cognitive impairment
Dementia with Lewy bodies
Frontotemporal dementia

Key challenge
Clinical criteria fail in early stage

World Alzheimer Report 2021; Prince et al., 2011

MRI
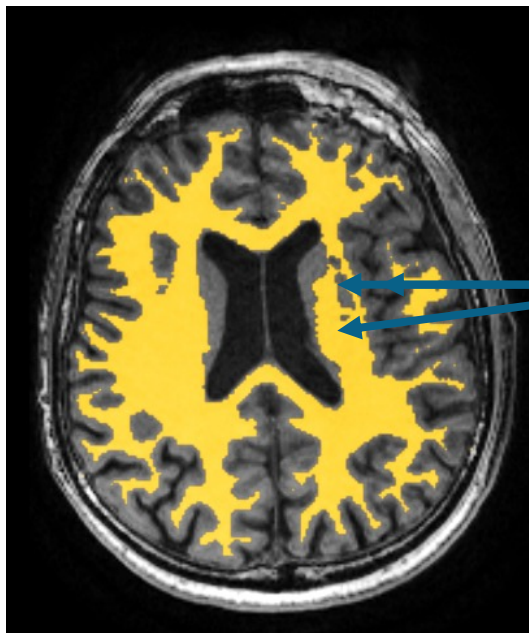
Witte stof
Grijze stof

MRI
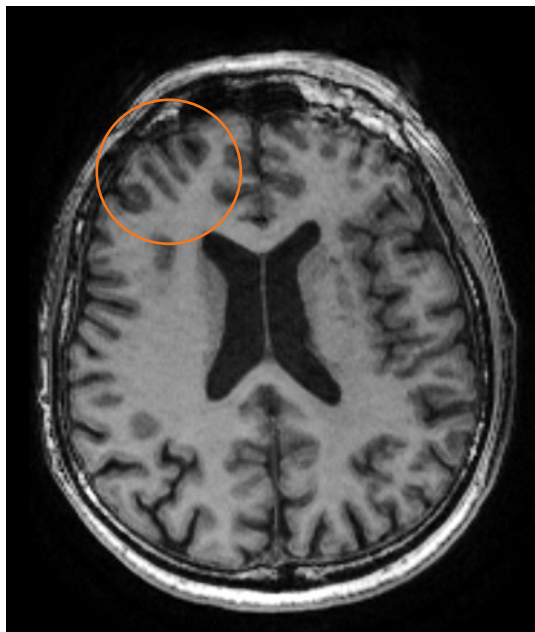
Gezond (man, 64 jaar)
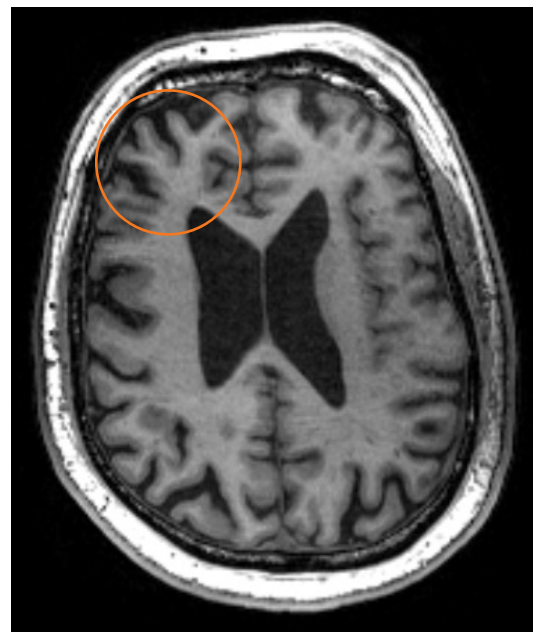
Ziekte van Alzheimer (man, 64 jaar)

Imaging biomarkers
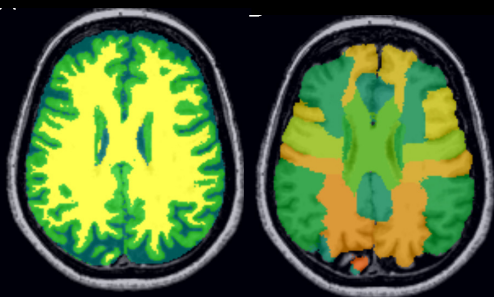
Brain volumes
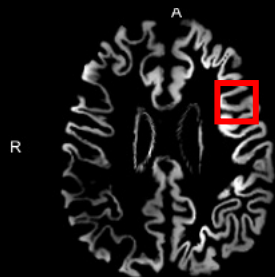
Voxel-wise information
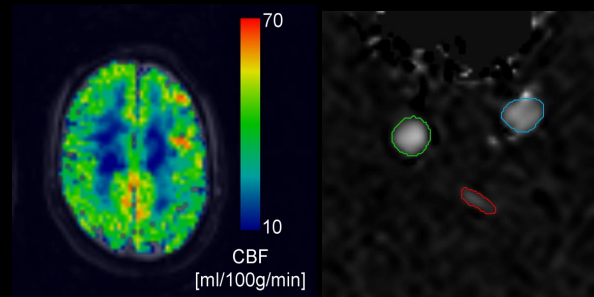
Perfusion MRI (ASL. Qflow)
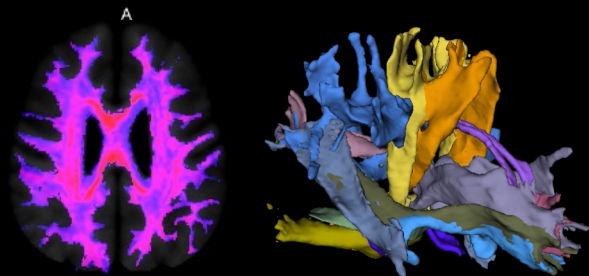
WM microstructure (DTI)
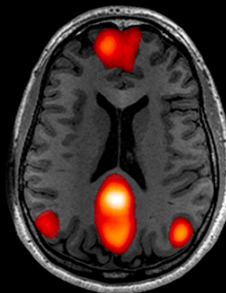
fMRI
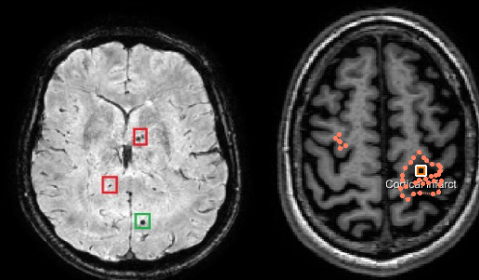
Other (microbleeds, infarcts)

AI advances dementia diagnosis

Imaging data

Clinical data

~~Dementia yes/no~~

Etiological diagnosis
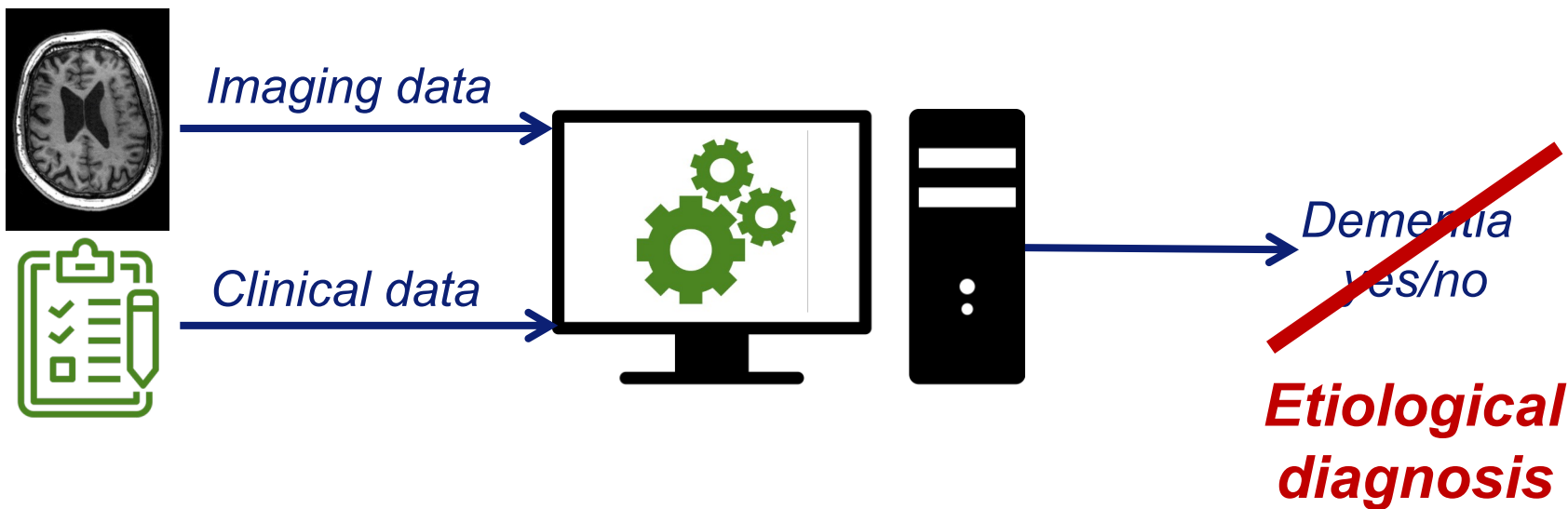
- *Very successful in Alzheimer's disease research (Bron et al., 2015; 2021)*

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Need for data

- Machine learning methods learn from large datasets
- Availability of multi-center clinical data for research is limited

- Single hospitals only have few cases of rare dementia subtypes

- Machine learning methods should learn from diverse datasets
  - Different populations
  - Variation in MRI scanners, variation in MRI sequence

- We need: more collaboration and reuse of data!

National Health-RI portal
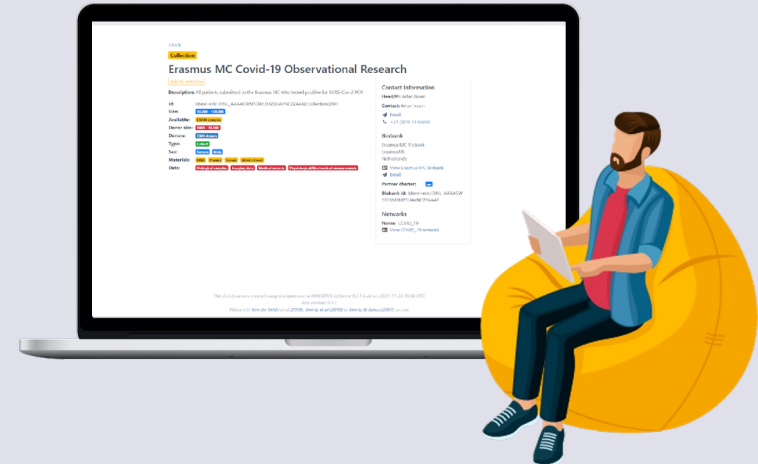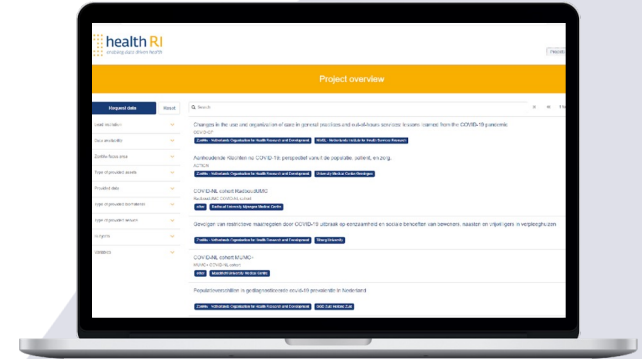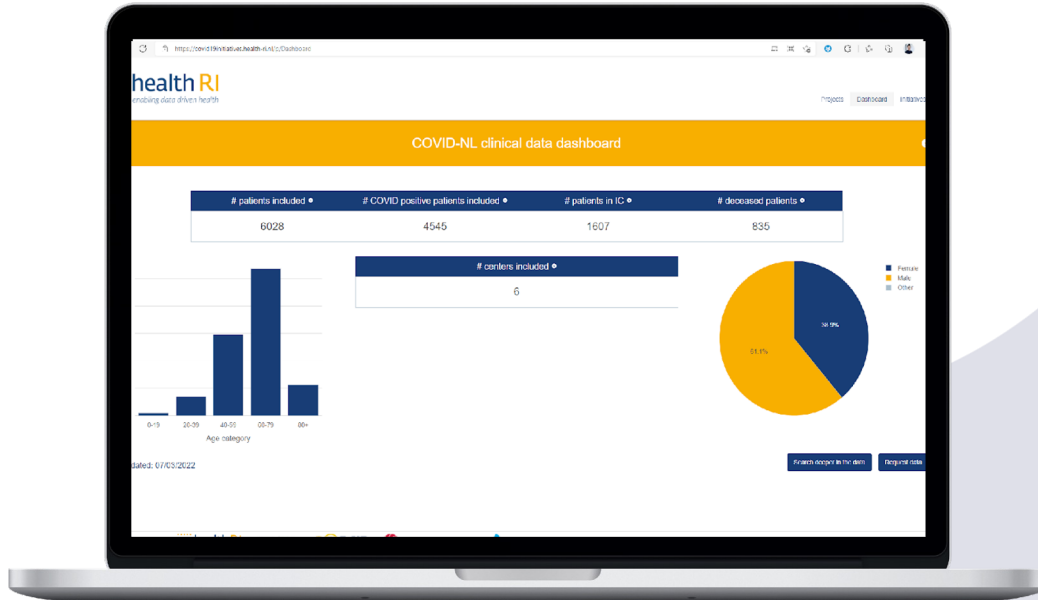
Goal Imaging: Make image data available to portal

- What: Make metadata and data of medical images available
- How: Together with representative of Health-RI nodes

- Imaging Working group (since October 2022)
  - Collaborate step-by-step towards this goal
  - Architecture and design for making imaging data available
  - Actual implementation in the regions, starting with own organization
  - Lead: Esther Bron
- Imaging Community (since 2018)
  - Wider perspective, get feedback, seminars on imaging data infrastructure
  - Lead: Stefan Klein

Imaging werkgroep

- Werkgroep bestaat uit representanten van regionale knooppunten
  - AUMC: Paul Groot and tactical lead Ronald van Schijndel
  - UMCU: Wouter Veldhuis, Rudy van der Lek (and lead architect Ruud Bongers)
  - Radboudumc: Colin Jacobs
  - LUMC: Michele Huijberts, Marius Staring
  - UMCG: Eduard Boer, Martijn Veening
  - Erasmus MC: Esther Bron, Stefan Klein, Hakim Achterberg
  - MUMC+: t.b.d. (lead architect Igor Schoonbrood / tactical lead Pascal Suppers)
  - e/MTIC: t.b.d. and tactical lead Toine Kuiper

- Deelnemers zijn verantwoordelijk voor
  - Architectuur en ontwerp voor het beschikbaar maken van beelddata
  - Daadwerkelijke implementatie daarvan in hun eigen regio, te beginnen met eigen organisatie

XNAT

- Platform for storage, sharing, and management of medical imaging data
- XNAT software is open-source (www.xnat.org), active community
- National & European platform for medical imaging data management and sharing
- Most UMCs have their own XNAT as well
- Imposes structure: project / subject / experiment / scan
- Access control:
  - public / restricted / private projects
  - owner / member / collaborator user roles

Take home message

- AI / machine learning is main workhorse in medical image analysis nowadays

- Data sharing essential to develop medical imaging analysis methods that will benefit clinicians and patients

- AI in medical imaging is more than just data science:
  - Close collaboration with clinicians is crucial to make sure we solve meaningful problems

- Each UMC has expertise on working with imaging data (Imaging WG)
  - Connect to local expertise (e.g. at Radiology Imaging Trialbureau)
  - Local imaging research databases (XNAT, grand-challenge.org)

Sharing images

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