

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

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Data stewards course - Health-RI



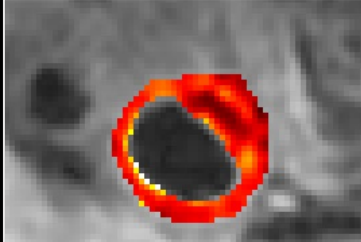
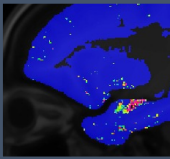
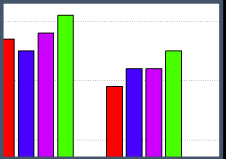
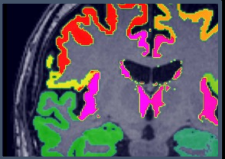
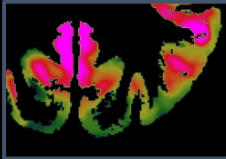
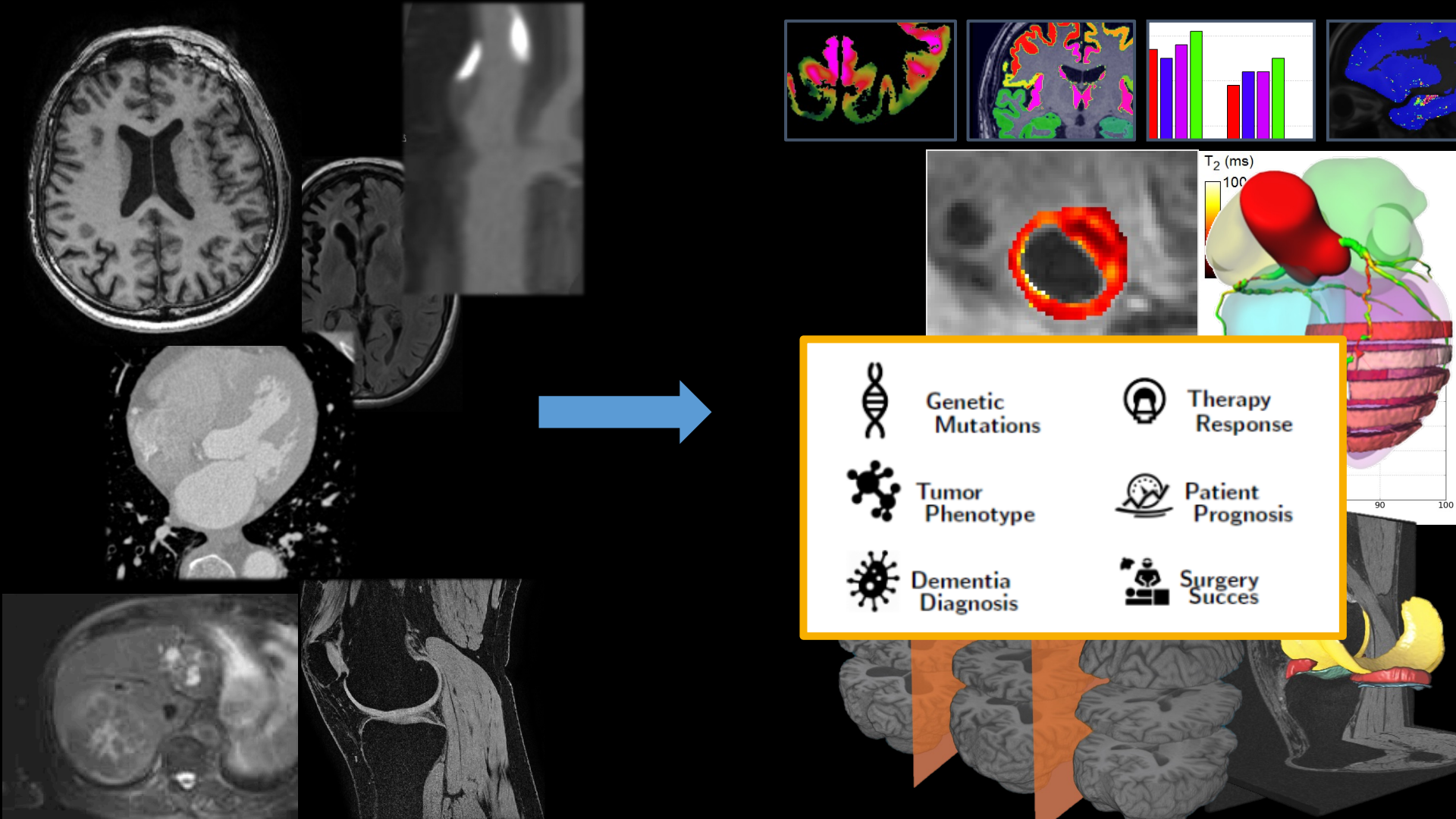
Erasmus MC
University Medical Center Rotterdam









Learning objectives

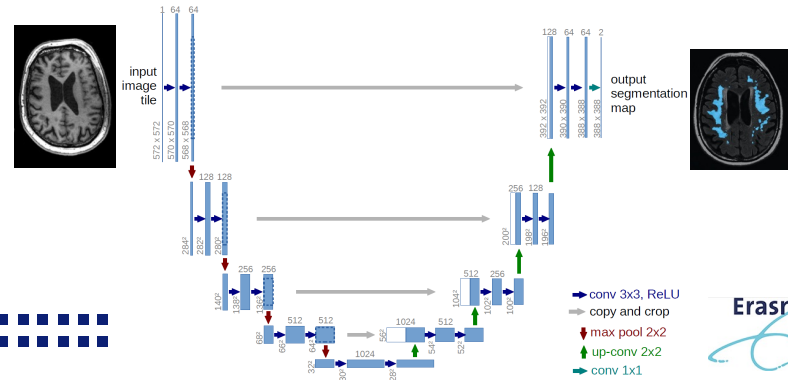
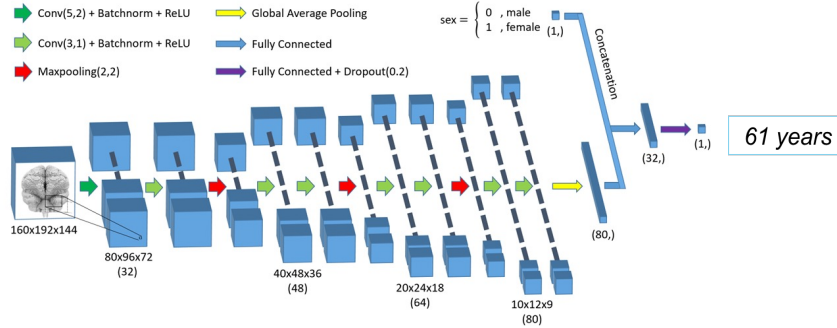
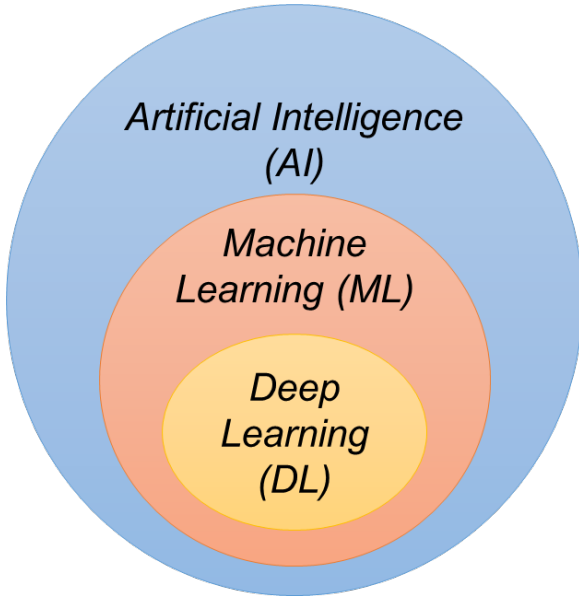
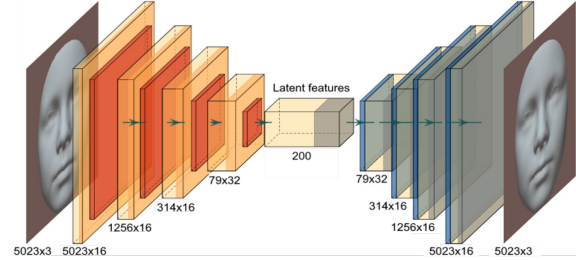
- Insight into research with medical images
- Understanding how machine learning is crucial in medical imaging research
- Understanding the need for data sharing in image analysis research
- Understanding how Health-RI and data stewards can play an important role here



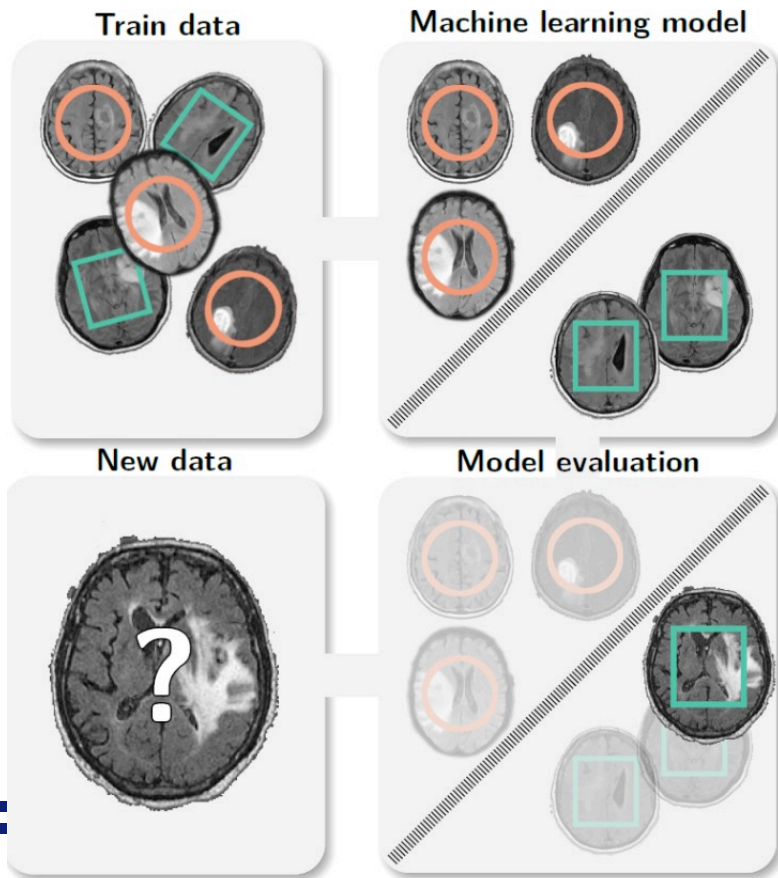


	Genetic Mutations		Therapy Response
	Tumor Phenotype		Patient Prognosis
	Dementia Diagnosis		Surgery Success

Artificial intelligence



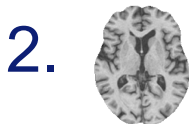
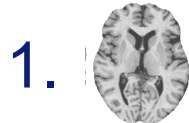
(Supervised) machine learning



Training data:

Input

Output

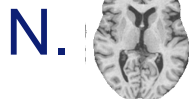


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⋮

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⋮





Etiological diagnosis

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

Key challenge

Clinical criteria fail in early stage

Kleinkinderen
Jan en Margareta
Dai
Anne
Sofia

Mijn broers:
Dix
Karel

Verjaardag
Van mij
do 30 oktober

Mijn kinderen
Eerste zoon Jan
Tweede zoon Ton
Dochter Tinneke

Ik ben
68 jaar

Mijn adres:
Van Boven-
straat 207
1115

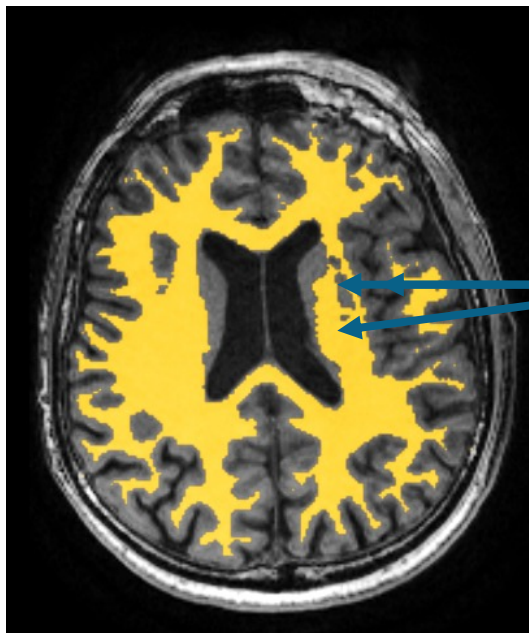
Ton's vriendin
Suzanne

Medicijnen
in verpakking
binnenin

Tweede
010-
1489077

010-
1489077
in de
telefoon

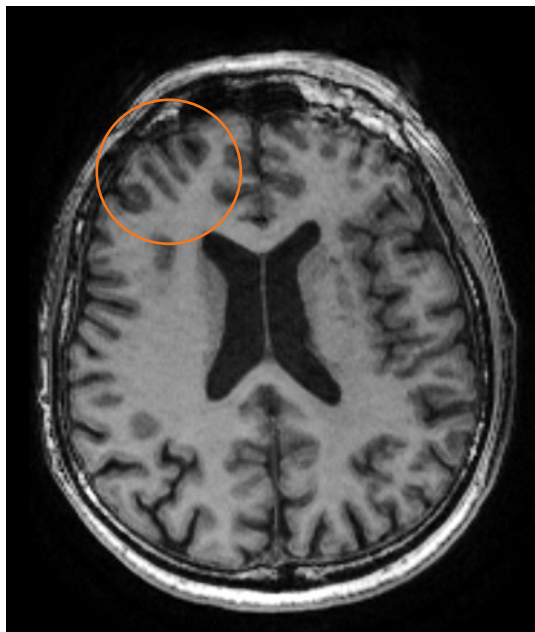
MRI



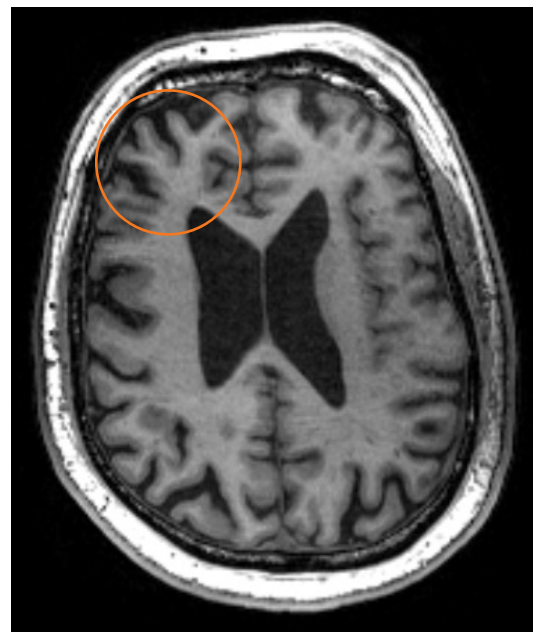
Witte stof



MRI

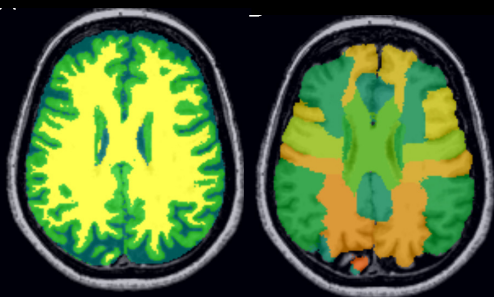


Gezond (man, 64 jaar)

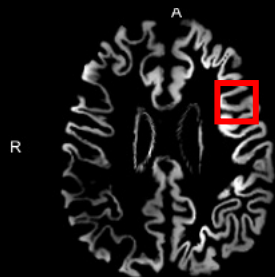


Ziekte van Alzheimer (man, 64 jaar)

Imaging biomarkers

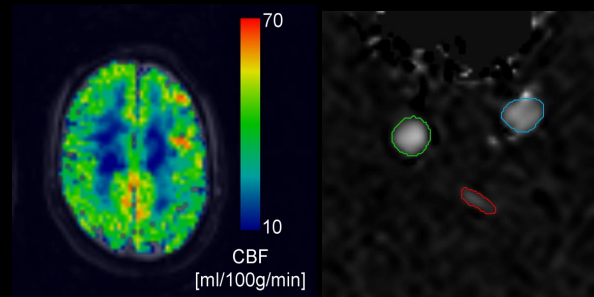


Brain volumes

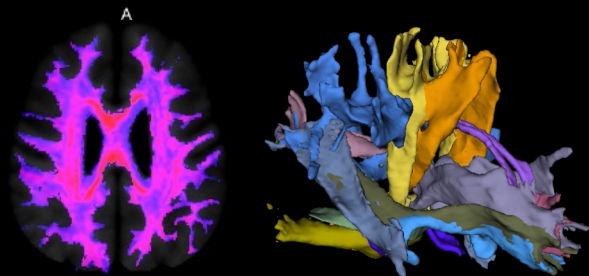


Voxel-wise information

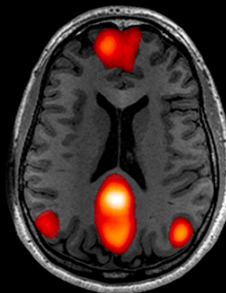
200	123	199	133	65	50
101	156	144	55	125	70
188	171	33	72	40	189
102	102	44	56	80	60
150	131	30	91	195	155
160	171	165	189	173	60



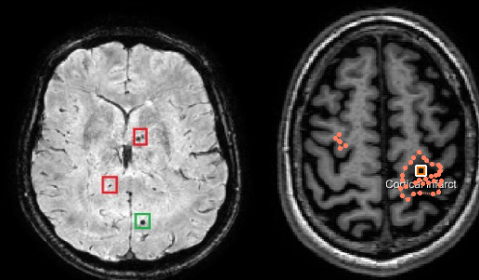
Perfusion MRI (ASL, Qflow)



WM microstructure (DTI)

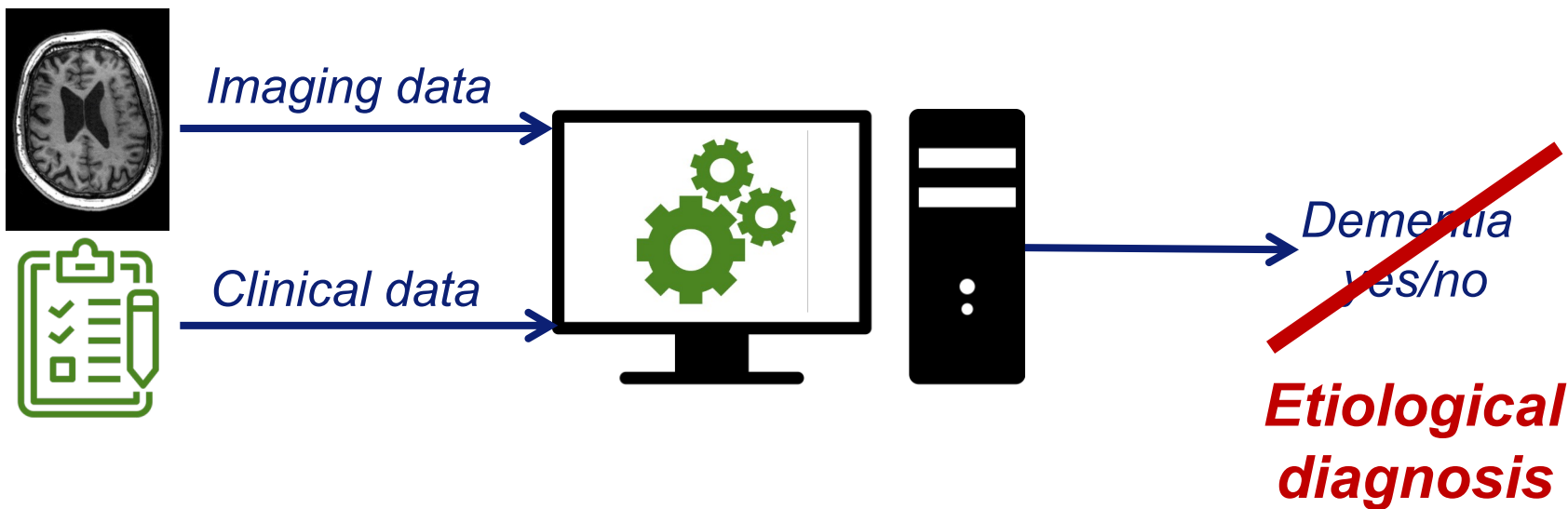


fMRI



Other (microbleeds, infarcts)

AI advances dementia diagnosis



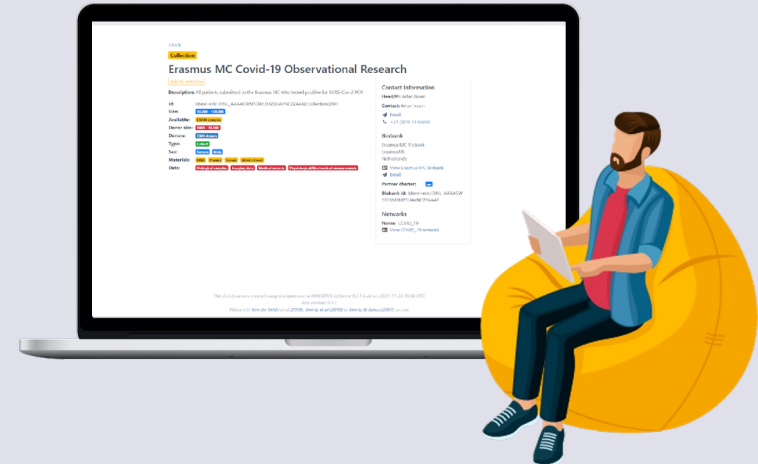
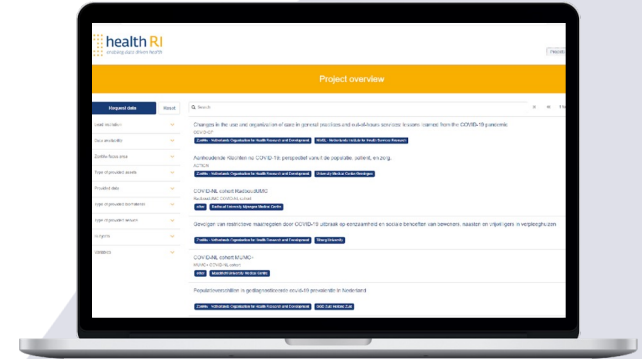
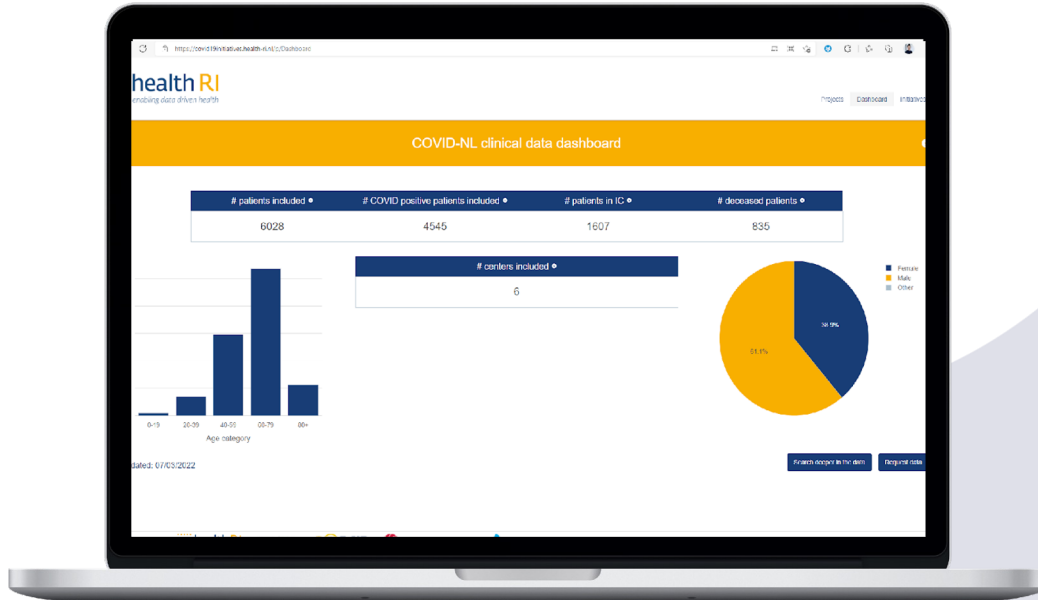
- *Very successful in Alzheimer's disease research (Bron et al., 2015; 2021)*

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

Search & find data | request & obtain | test & return



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



- 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

The screenshot shows the XNAT web interface. At the top, there is a navigation bar with 'Browse', 'New', 'Upload', 'Tools', and 'Help' menus. The main header features the 'trait a Health-RI platform' logo. Below the header, a status message indicates 'BMIAXNAT currently contains 212 projects, 18446 subjects, and 52382 imaging sessions.' The interface includes a search bar and a set of tabs for 'Projects', 'Subjects', 'MR', 'PET', and 'CT'. A form for creating or editing a project is visible, with fields for ID, Name, Description, Keywords, and Investigator. Below the form, there are two tables: 'Projects' and 'Recent Data Activity'. The 'Projects' table shows a project named 'BLTRotterdam' with details about its PI (Martijn Starmans) and the study's focus on liver tumors. The 'Recent Data Activity' table lists recent MR scans for the BLTParis project.

Projects	
BLTRotterdam	Project ID: BLTRotterdam PI: Martijn Starmans Study containing MR data of patients from the Erasmus Medical Center to access the Benignity of Liver Tumors (BLT) with a radiomics approach. You are an owner for this project.
STW_STRATEGY_MAASTRO_LUNG1	

Recent Data Activity		
BLTParis	MR	BLTParis-126
BLTParis	MR	BLTParis-124
BLTParis	MR	BLTParis-122
BLTParis	MR	BLTParis-121
BLTParis	MR	BLTParis-119
BLTParis	MR	BLTParis-118

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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