

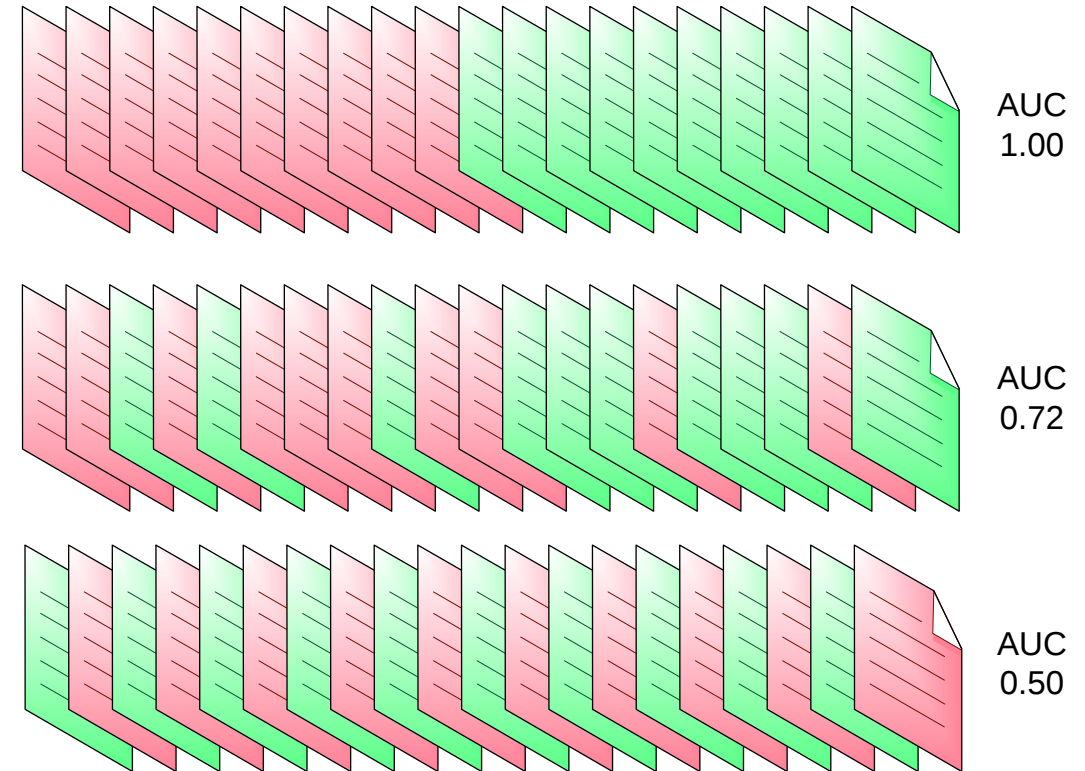
AI in de Zorg

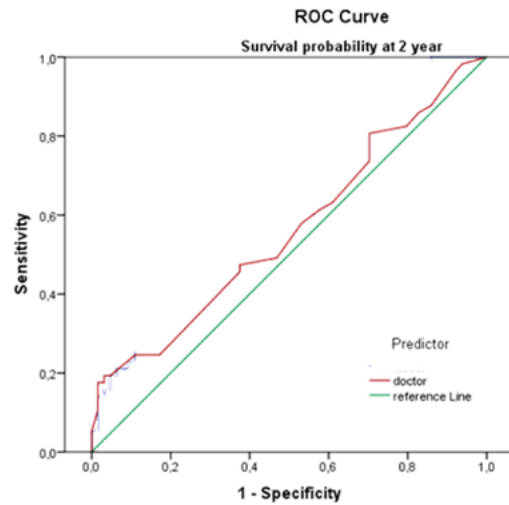
Andre Dekker

Klinisch Fysicus | Hoogleraar Clinical Data Science
Universiteit Maastricht | Maastricht Clinic | Maastricht UMC+
3e Netwerkdag ICT-advisers gehandicaptenzorg
18-05-2024 | 10:20-11:10 (35+15)

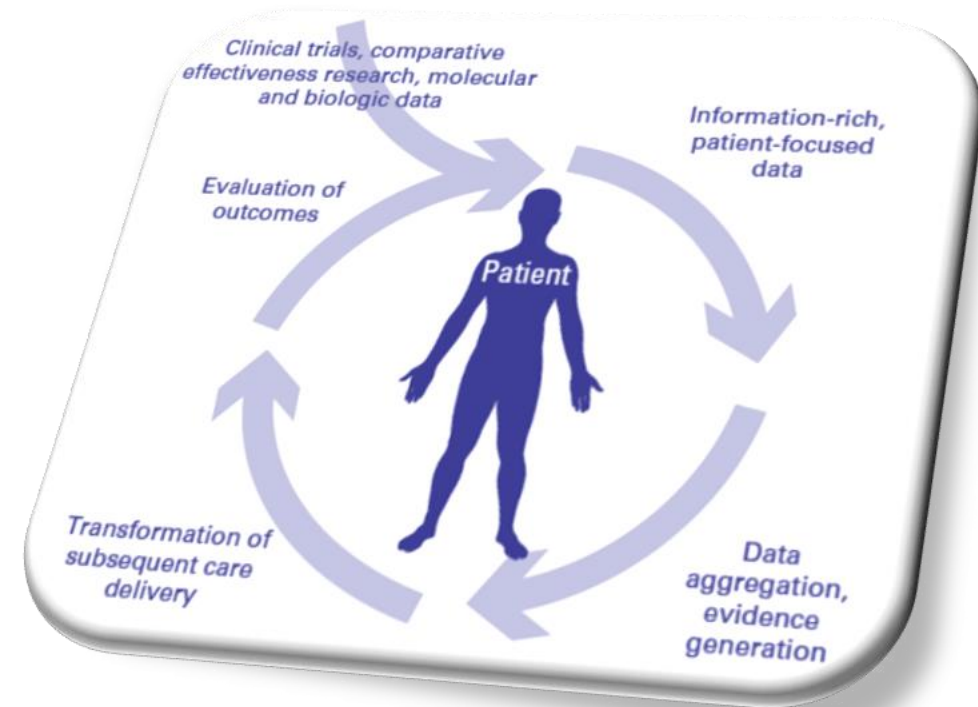


Hoe goed zijn wij in uitkomsten voorspellen?





Longkanker
2 jaar overleving
158 patiënten
5 dokters
Prospectief
AUC: 0.56
2006





Het probleem is data fragmentatie



Oncology
2007-2017
150M patients
0.1-10GB per patient

15-1500PB
80% unstructured

Hospitals
China: 25.000
India: 35.000
Germany: 2.000
France: 2.300
Italy: 1.100
USA: 5.500
Australia: 1.400

TOTAL ~100.000

Hospitals 100.000
Physicians 9.000.000
Patients 150.000.000
People 8.000.000.000
IoT 17.000.000.000



Waarom is data delen zo moeilijk?

[..] the problem is not really technical [...]. Rather, the problems are **ethical, political, and administrative.**

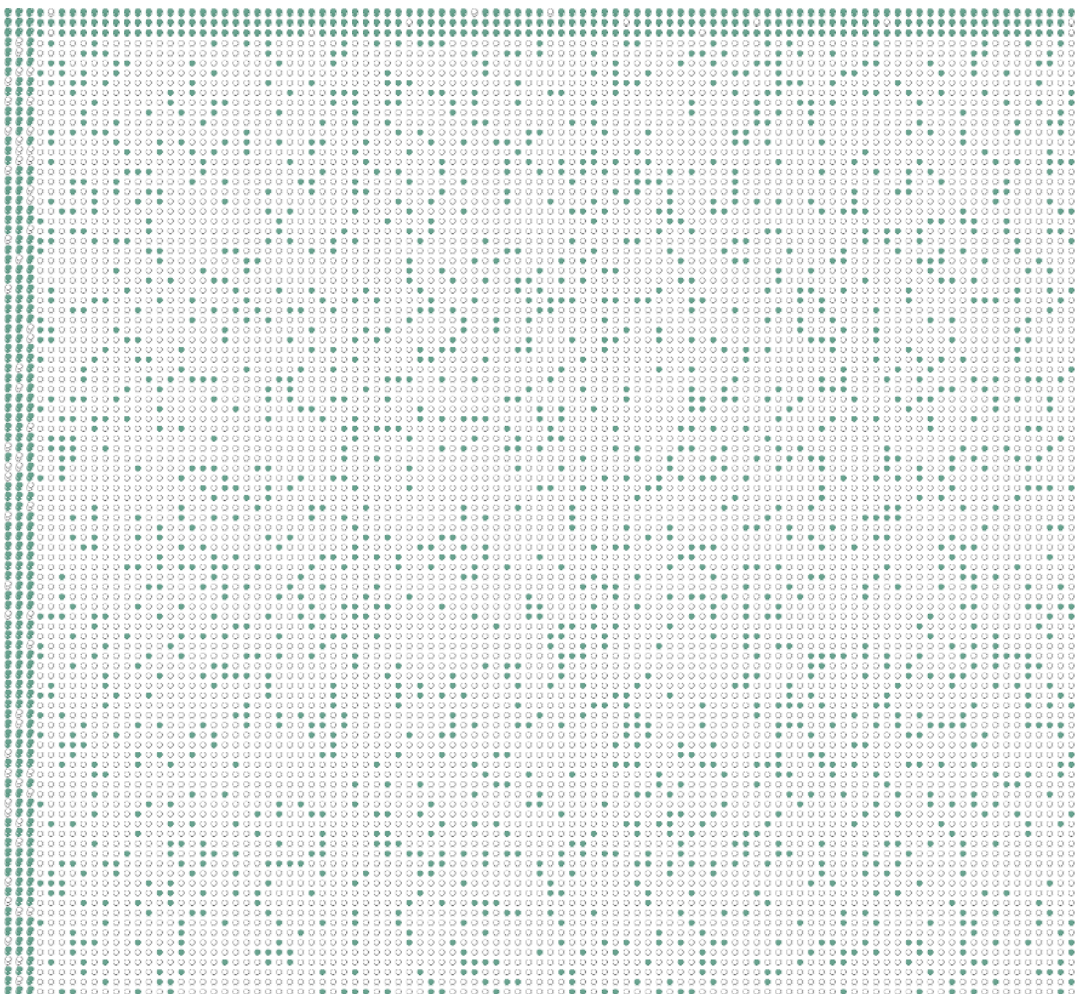
Lancet Oncol 2011;12:933

1. Administratief (Ik heb er geen tijd voor)
2. Politiek (Ik wil het niet)
3. Ethisch/juridisch (Ik mag het niet)
4. Technisch (Ik kan het niet)



Data elementen

Personen



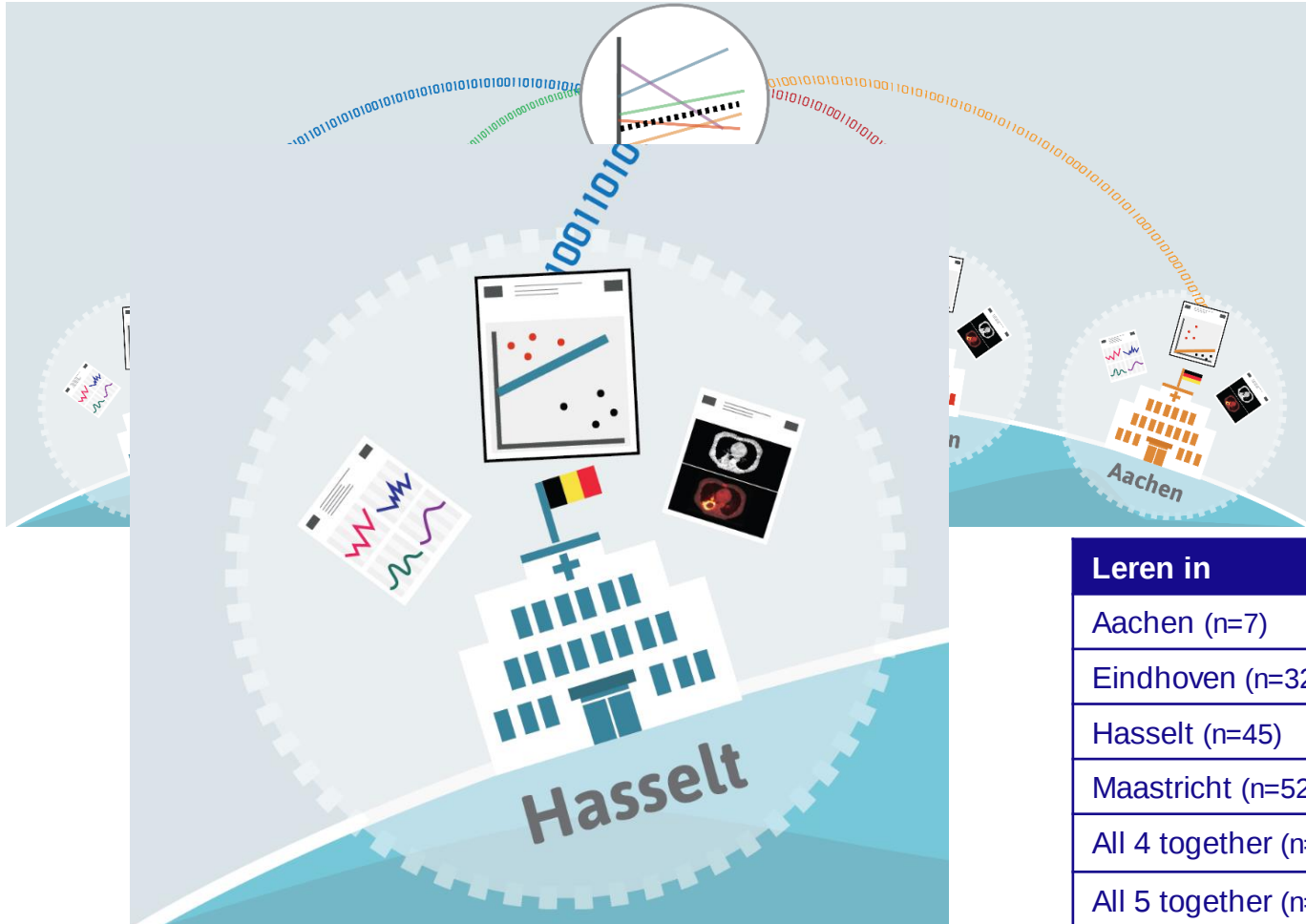
- Onderzoek
 - 3% van de personen
 - 100% van de elementen
 - 5% missend
 - 285 data punten
- Registraties
 - 100% van de personen
 - 3% van de elementen
 - 20% missend
 - 240 data punten
- Routine
 - 100% van de personen
 - 100% van de elementen
 - 80% missend
 - 2000 data punten

- Als data delen het probleem is, doe dat dan niet
- Als je de data niet naar het onderzoek kan brengen dan...
- moet je het onderzoek naar de data brengen
- Uitdagingen
 - De onderzoeksvraag moet gestuurd kunnen worden (treinen & spoor)
 - De data moet begrepen kunnen worden door een applicatie (en niet door een mens) -> FAIR data stations





Werkt dat? Interreg IV – euroCAT (2010)

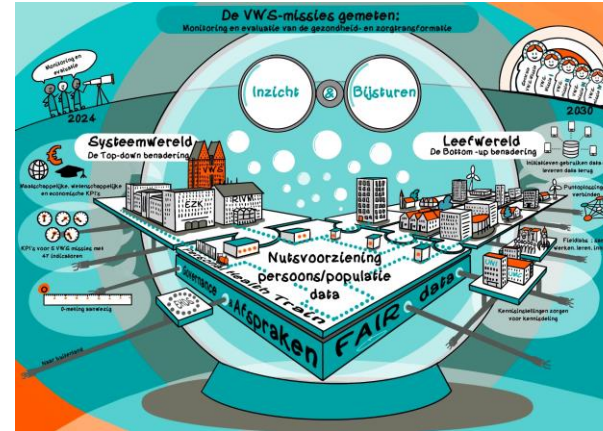


Leren in	Valideren in	AUC
Aachen (n=7)	Liège (n=186)	0.61
Eindhoven (n=32)	Liège (n=186)	0.72
Hasselt (n=45)	Liège (n=186)	0.68
Maastricht (n=52)	Liège (n=186)	0.75
All 4 together (n=136)	Liège (n=186)	0.77
All 5 together (n=322)	World (n=inf)	?



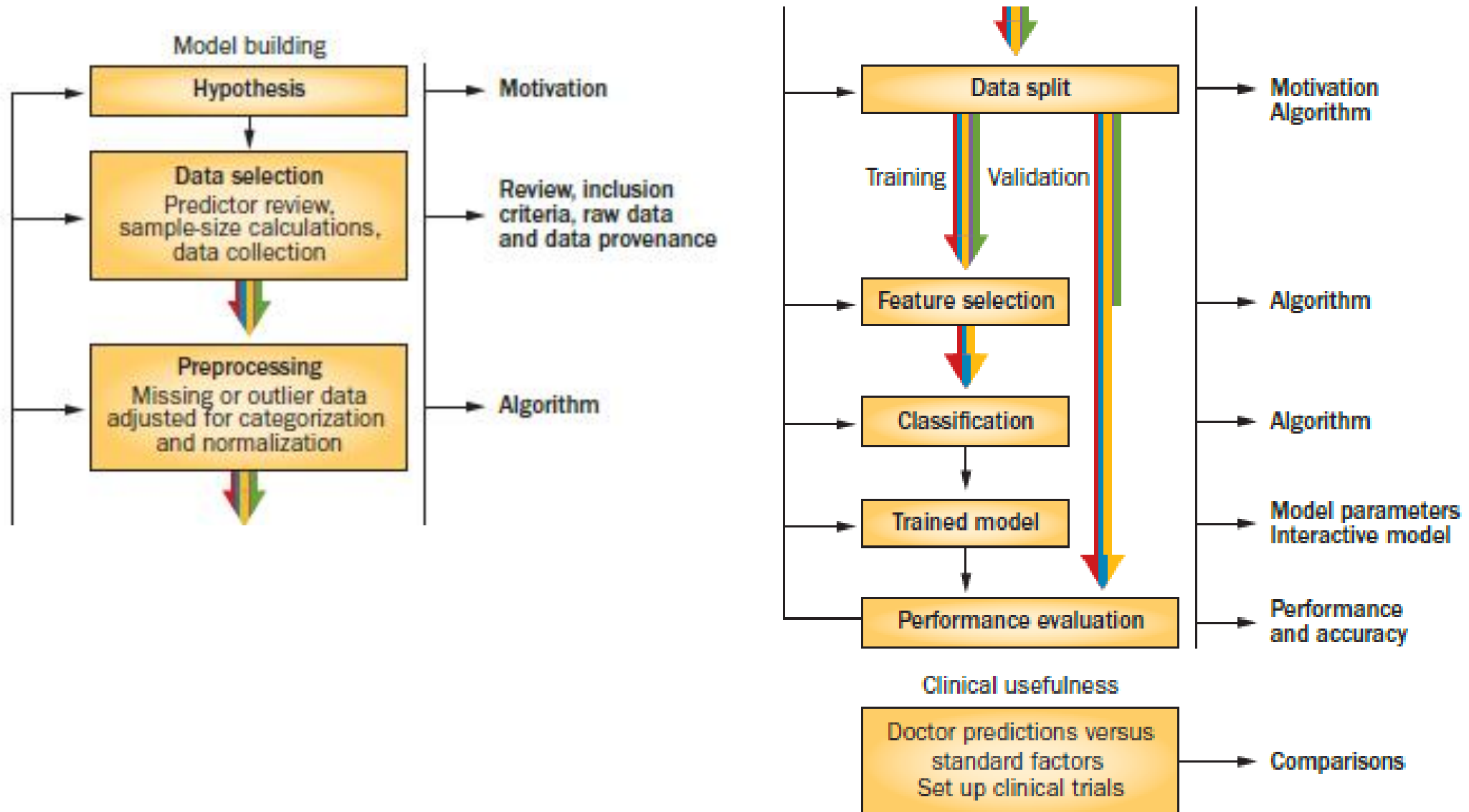
11/02/2021

NL AIC geeft inzicht in state of the art data delen



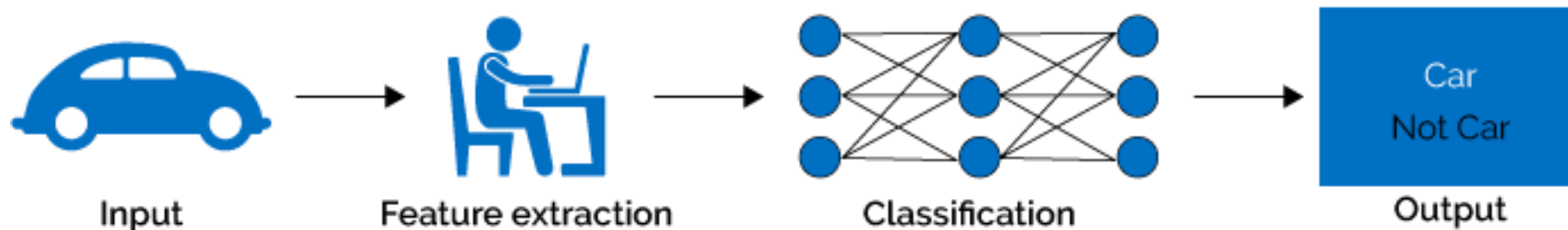
Zorginstituut Nederland

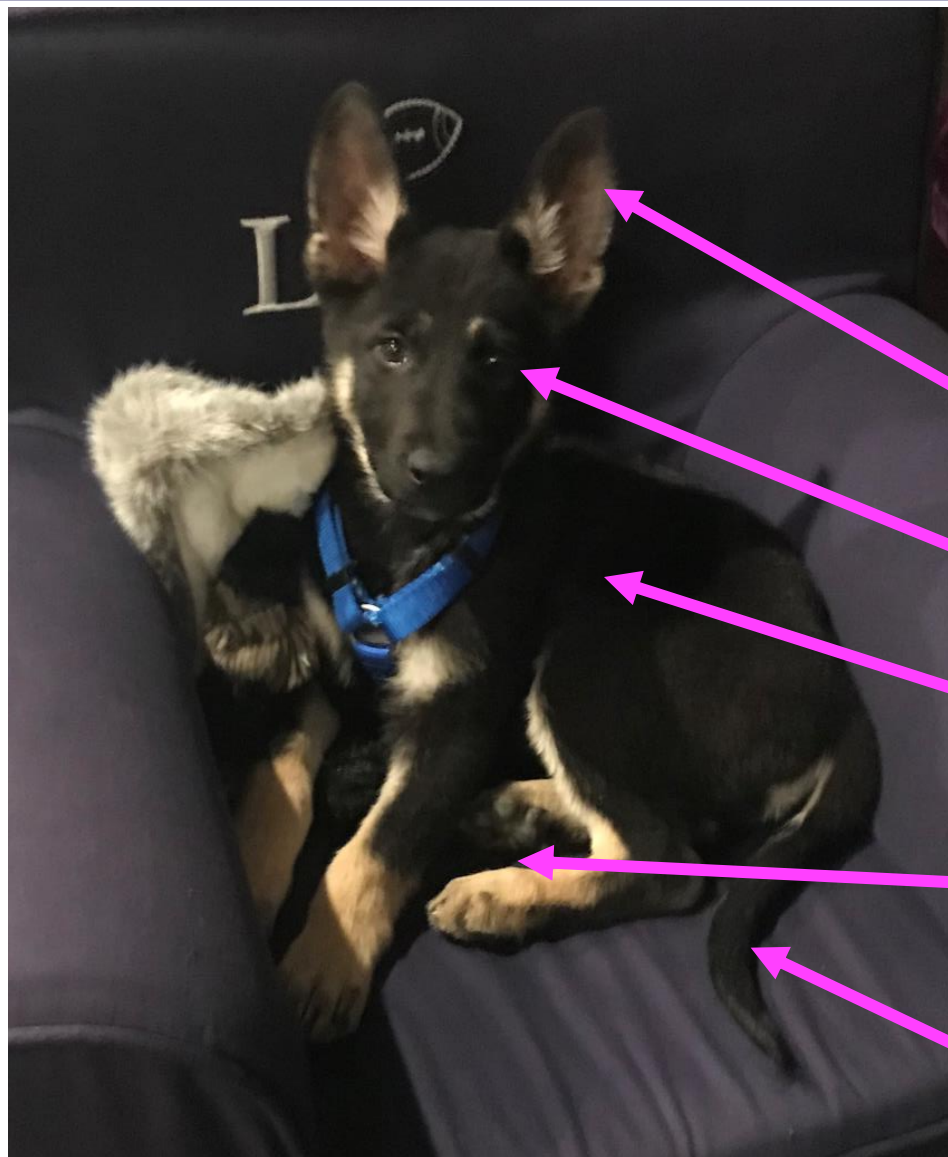






Machine Learning





Oren

Ogen

Vacht

Poten

Staart

Geen Kat!

Kat: 97%

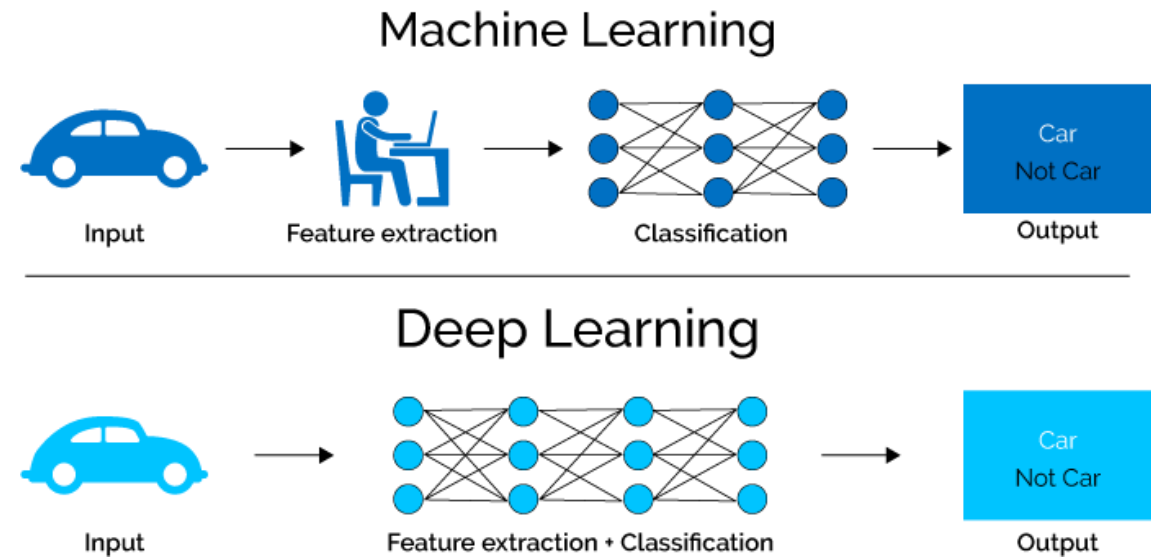
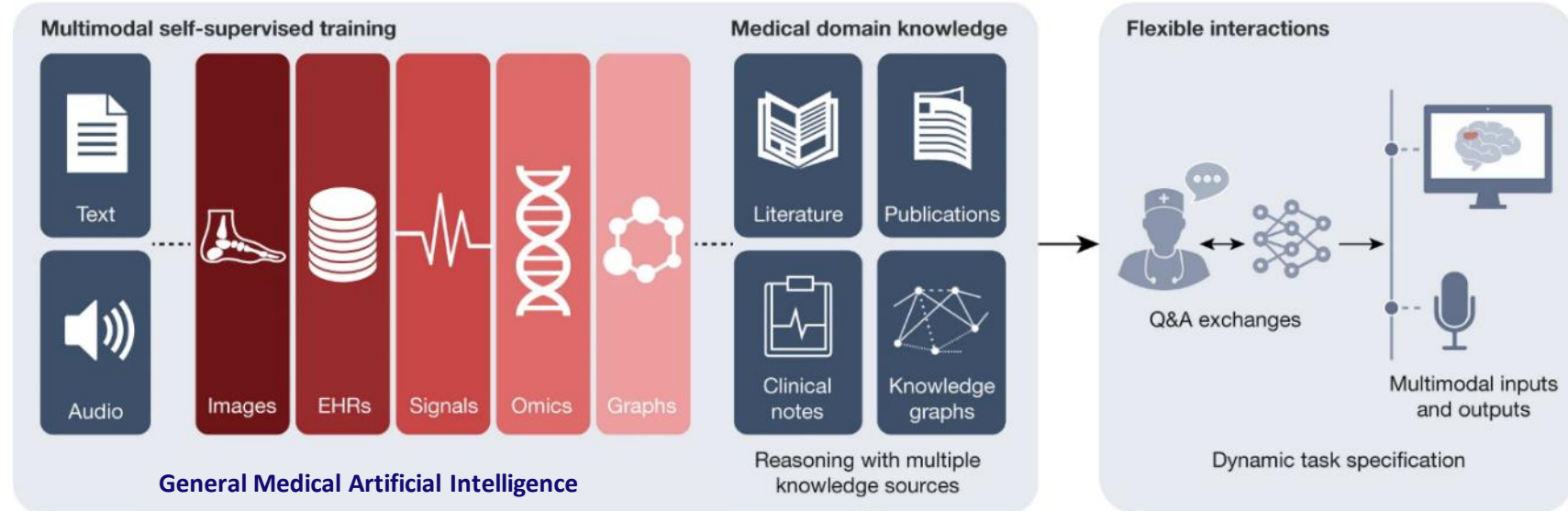
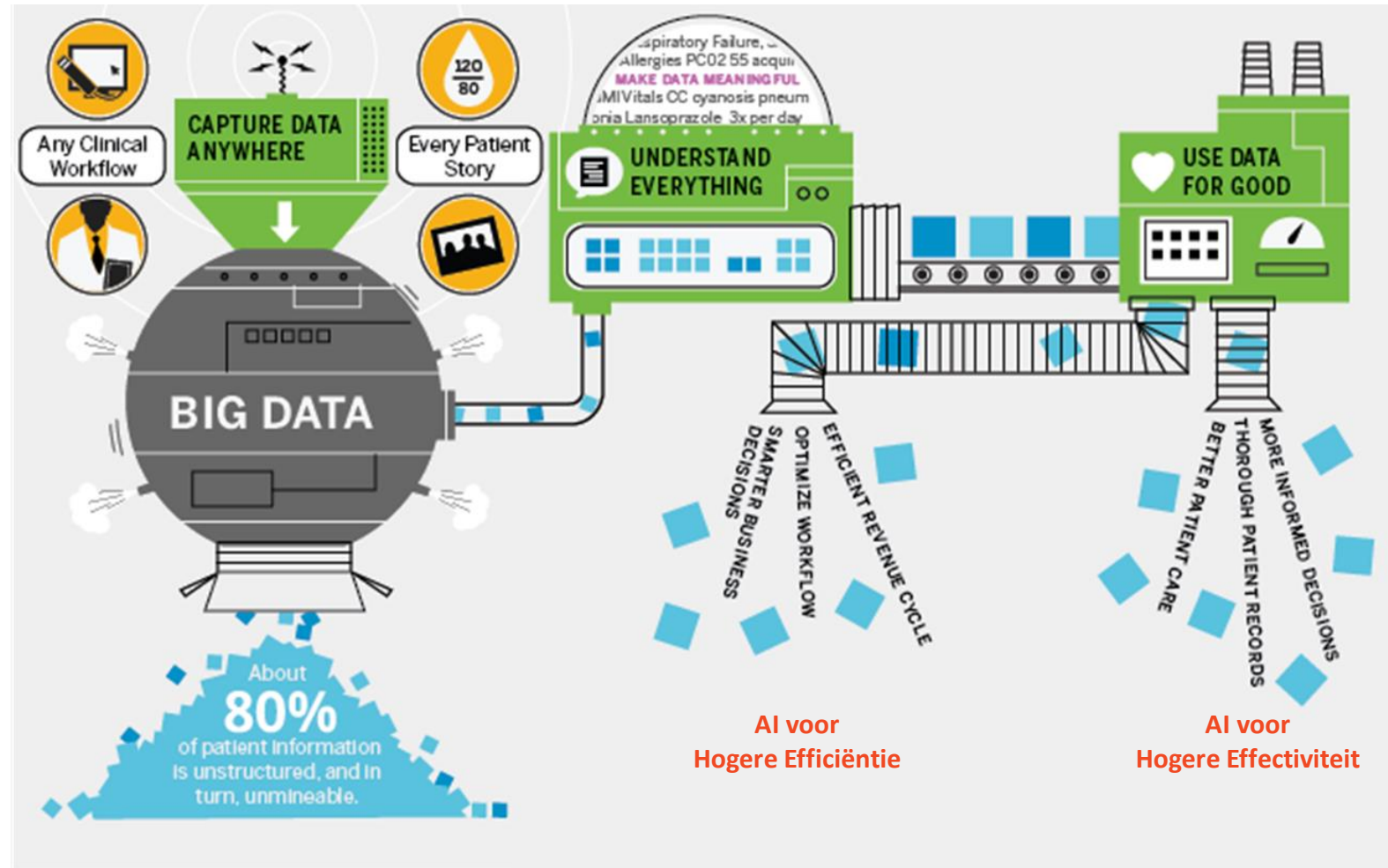


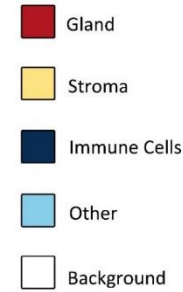
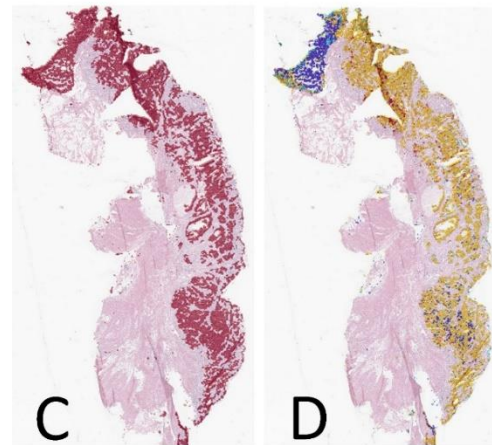
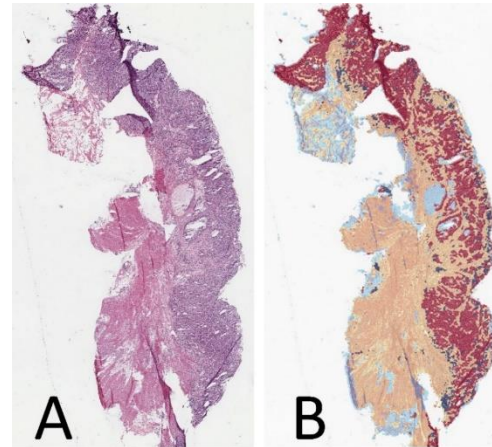
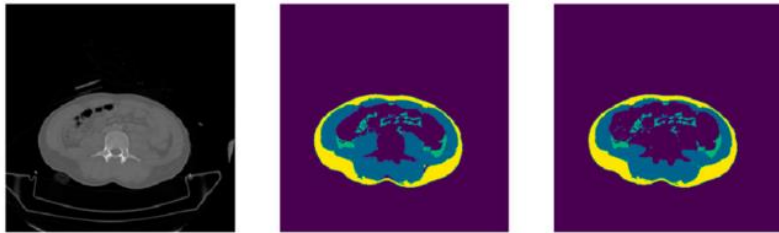
Table 3 | Comparisons between human evaluations and different types of AI approaches

Approaches	Model comprehensibility	Performance	Reproducibility	Dependency on prior knowledge	Development and training costs ^a	Running costs	Around-the-clock availability	Update costs
Human evaluation	High	Moderate or high	Moderate	High	High	High	Low	High
Rule-based algorithms	High	Moderate or high	High	High	Moderate or high	Low	High	High
Feature-based machine-learning methods	Moderate or high	Moderate or high	High	Moderate ^b	Moderate	Low	High	Moderate ^c
Deep artificial neural networks	Low or moderate	High	High	Low	Moderate	Low	High	Low

Deep Learning en verder Self Supervised & Generalist & Multimodaal & Interactief







← →

Clinical details:
Pulmonary malignancy?

Report:
CT thorax and abdomen, arterial phase

Thorax:
Mass visible in the left upper lobe with a maximum size estimated at 8-46 of 4.7 x 3.0 cm. Possible involvement in mediastinum. Satellite nodes visible at 8-41 with an estimated size of 1.3 cm. Lymph node visible at station 7 with a size of circa 5,2 cm. No lymph nodes visible at contralateral side. Small consolidation middle lobe. No indication of atelectasis.

Abdomen:
Multiple sharply edged hypodens lesions visible which would initially match with cysts (HU 5). No relevant musculoskeletal findings

Conclusion:
Tumour with satellite nodes left upper lobe

POWERED BY TINY

TNM-8 Lung

English

Classify

T3 N0 M

Primary Tumor

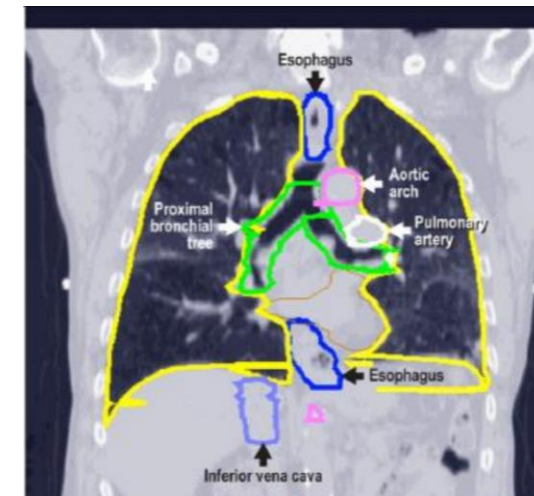
4.7 cm Left Side

Present Involved

☒ Satellite Nodule (T3) ☐ Ipsilateral Tumor (T4)

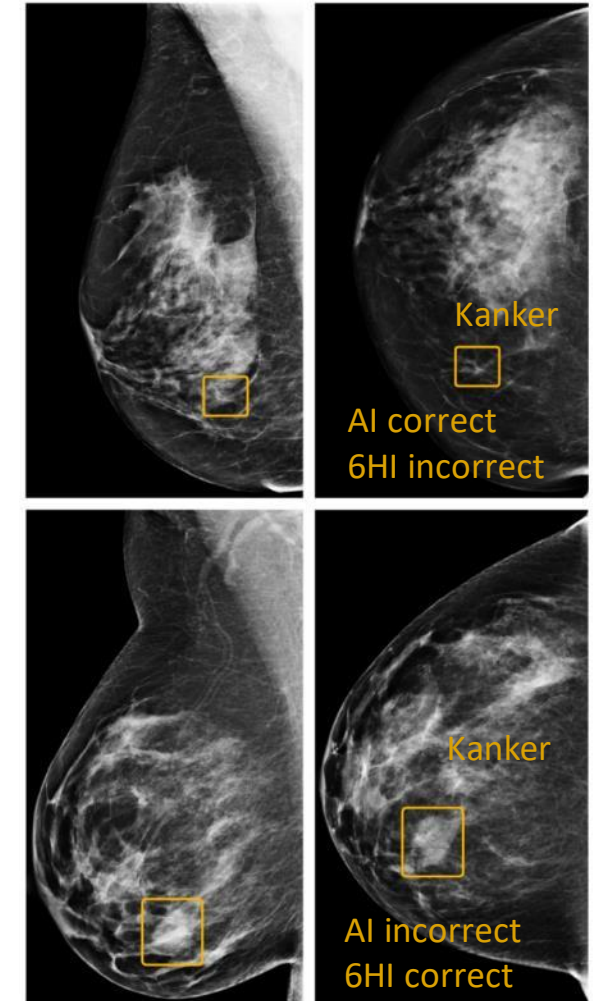
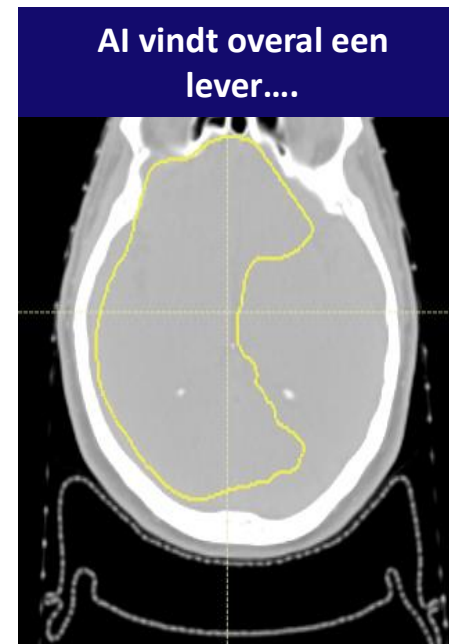
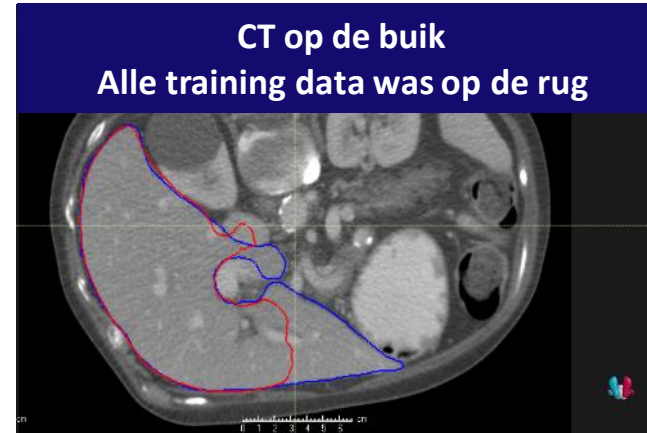
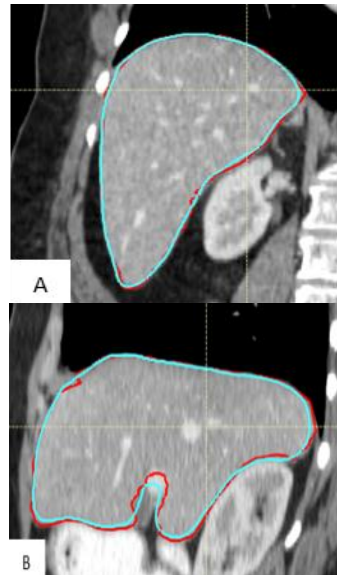
Lymph Nodes

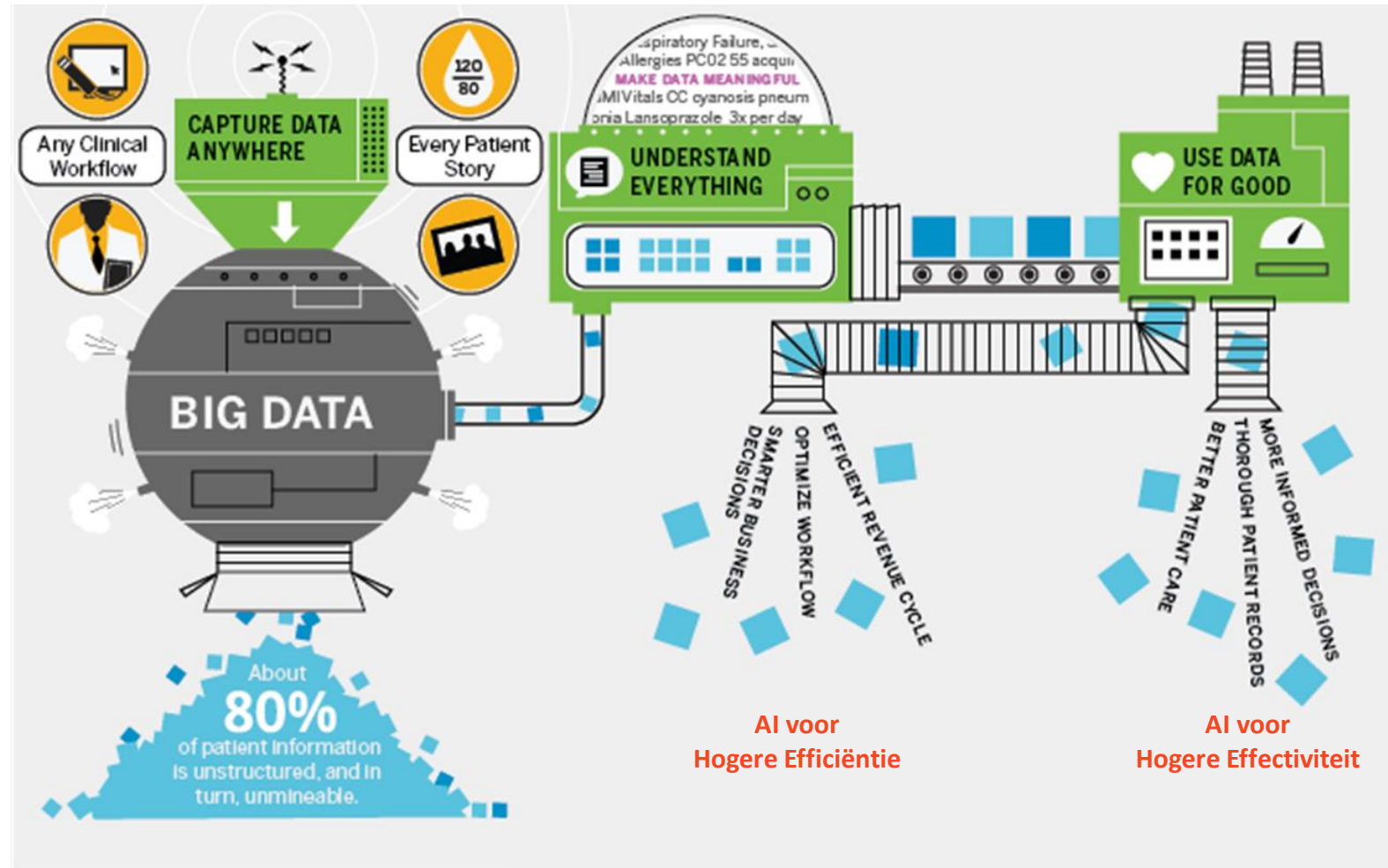
Pathologic Lymph Nodes

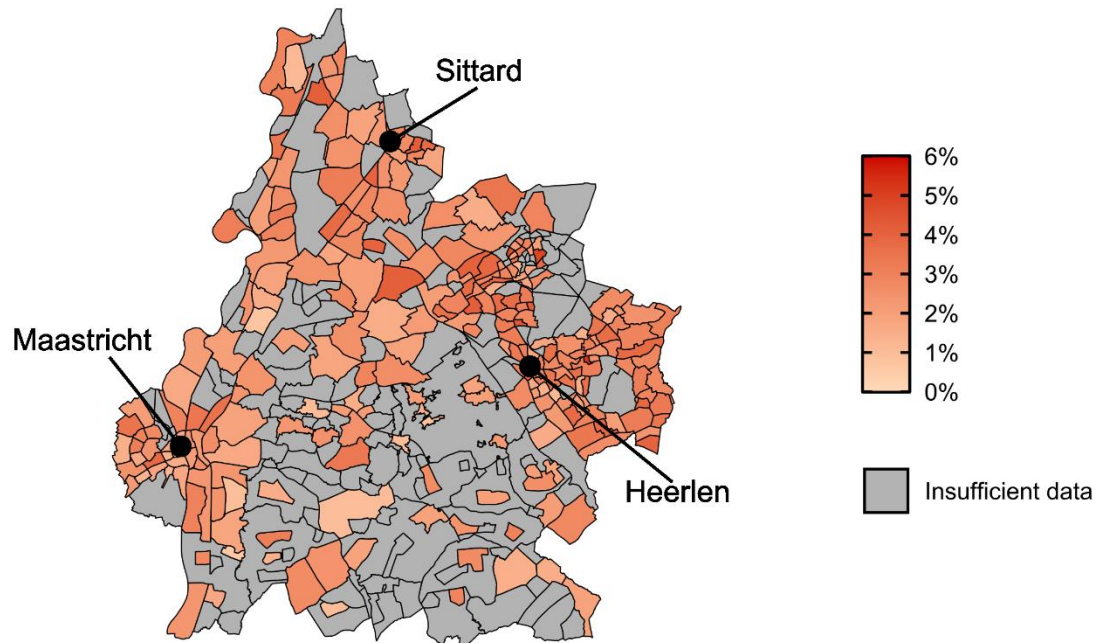


AI bepaalt de huidige situatie -> Black box oké

AI algorithms cannot be expected to perform at a higher level than their training data, but should deliver the same standard of performance consistently for data within the training space.







Standardised predictor	Subdistribution hazard ratio
male	2.12 (95% CI: 2.03 – 2.21)
age	1.80 (95% CI: 1.76 – 1.84)
wealth	0.96 (95% CI: 0.93 – 0.99)
education: low	1.04 (95% CI: 0.99 – 1.10)
education: high	0.90 (95% CI: 0.85 – 0.94)
particulate matter 2.5	1.13 (95% CI: 1.08 – 1.18)

AUC~0.68

CBS + DHD + RIVM
(N=307,189)

5-year atherosclerotic cardiovascular
disease (ASCVD) event rate

AID-HF English Nederlands

Do you feel short of breath when lying down (orthopnea)?

None Slight Moderate Severe

Do you have a dry cough?

None Slight Moderate Severe

Do you have swelling (edema)?

None Slight Moderate Severe

Do you feel dizzy?

None Slight Moderate Severe

Do you feel like fainting?

Yes No

Reset Submit

AID-HF English Nederlands

Based on your symptoms, we recommend you to:



Increase the dose

Restart

PASSION-HF
PAtient Self-care uSIng eHealth In chrONic Heart Failure

Welkom,
meneer Janssen

Mijn gegevens

Mijn behandelopties

Operatie

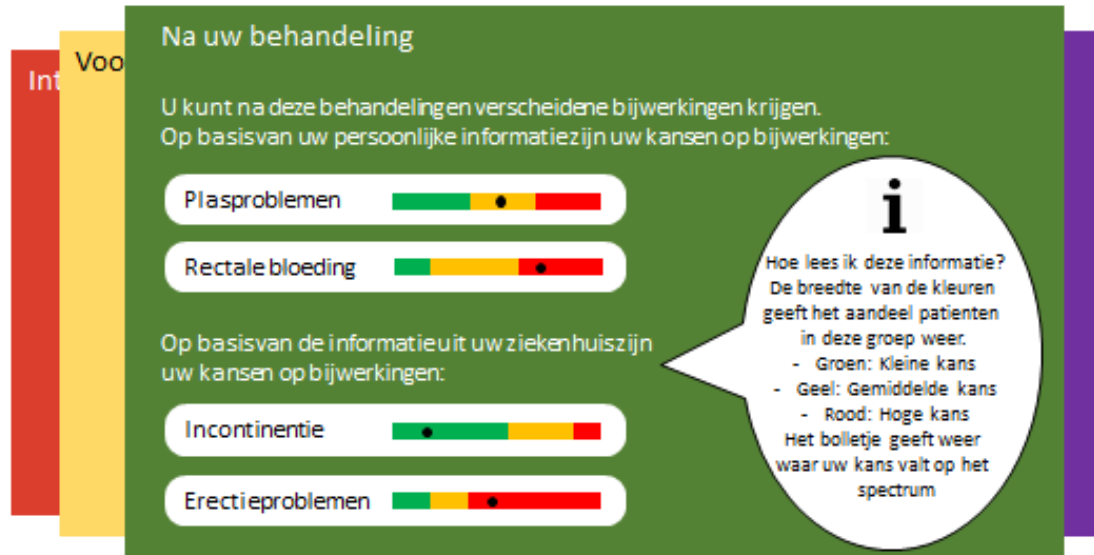
Inwendige bestraling

Uitwendige bestraling

Actief volgen

Mijn voorkeuren

Mijn resultaten



Zorginstituut Nederland



ProstaatKankerStichting.nl
Jouw Gids in ProstaatKanker



Maastricht



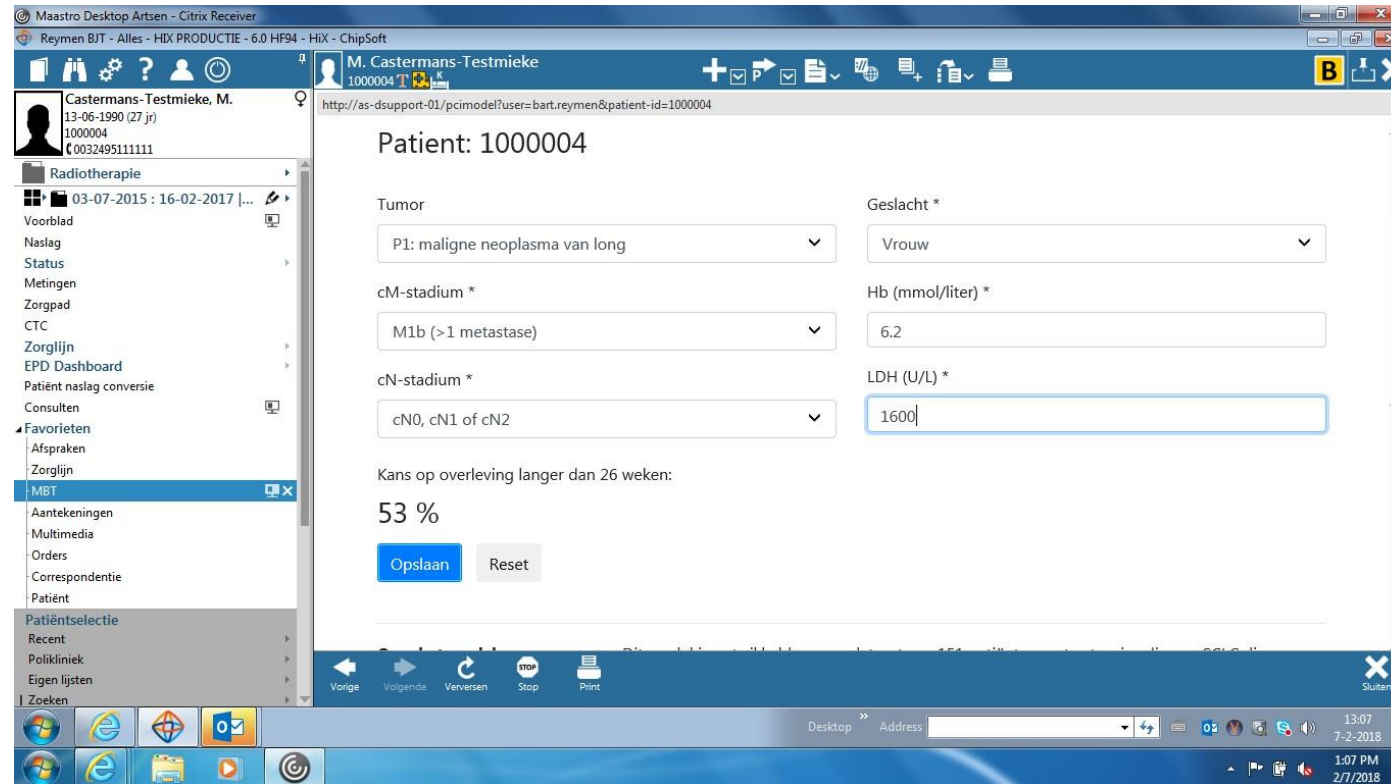
PATIENT+



Oncologisch Netwerk
Zuidoost-Nederland



**ZU
YD**



The screenshot shows a web-based medical application interface. At the top, it identifies the user as 'M. Castermans-Testmieke' and the patient as 'Patient: 1000004'. The left sidebar contains a navigation menu with options like 'Radiotherapie', 'Voorblad', 'Naslag', 'Status', 'Metingen', 'Zorgpad', 'CTC', 'Zorglijn', 'EPD Dashboard', 'Patiënt naslag conversie', 'Consulten', 'Favorieten', 'Afspraken', 'Zorglijn', 'MBT', 'Aantekeningen', 'Multimedia', 'Orders', 'Correspondentie', 'Patiënt', 'Patiëntselectie', 'Recent', 'Polikliniek', 'Eigen lijsten', and 'Zoeken'. The main content area displays patient details and clinical data:

- Tumor:** P1: maligne neoplasma van long
- Geslacht:** Vrouw
- cM-stadium:** M1b (>1 metastase)
- Hb (mmol/liter):** 6.2
- cN-stadium:** cN0, cN1 of cN2
- LDH (U/L):** 1600
- Kans op overleving langer dan 26 weken:** 53 %

At the bottom of the form are buttons for 'Opslaan' (Save) and 'Reset'. The interface also includes a status bar at the bottom with navigation controls (Vorige, Volgende, Verversen, Stop, Print) and a system clock showing 13:07 on 7-2-2018.



Korte Overleving
Geen PCI?



Ervaring Patiënt: Decisional
Conflict, Control Preference,
SDM



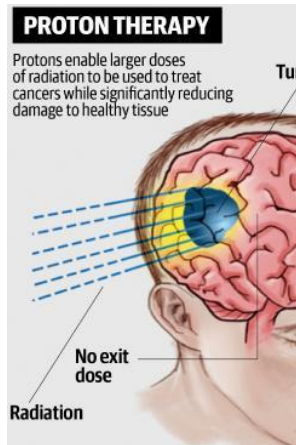
Ervaring Dokter,
SDM



Kosteneffectiviteit
Zorgpas



Indicatiestelling protonentherapie



3 protonen cer
1.600 slots en
10.000€ -> 50.
Geen bewijs
Wie krijgt het?





Pressure-Volume Loops in Cardiac Surgery

Proefschrift

ter verkrijging van de graad van doctor
aan de Universiteit Maastricht,
op gezag van de Rector Magnificus,
Prof.dr. A.C. Nieuwenhuijzen Kruseman,
volgens het besluit van het College van Decanen,
in het openbaar te verdedigen,
op vrijdag 12 september 2003 om 14:00 uur

door

André Dekker





Goed genoeg voor AI

Face++ 旷视
Cognitive Services

Technologies

SDK Products

Solutions

Pricing

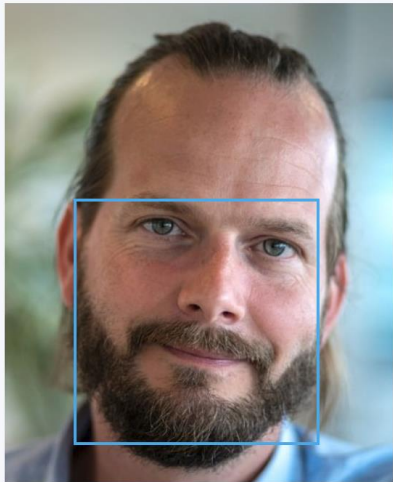
Resources

Support

Console

Sign Up





Compare Result

Response JSON

Is same person: Probability very high.

a | FaceAge Algorithm



b | Data

Discovery Datasets (n=58,851)

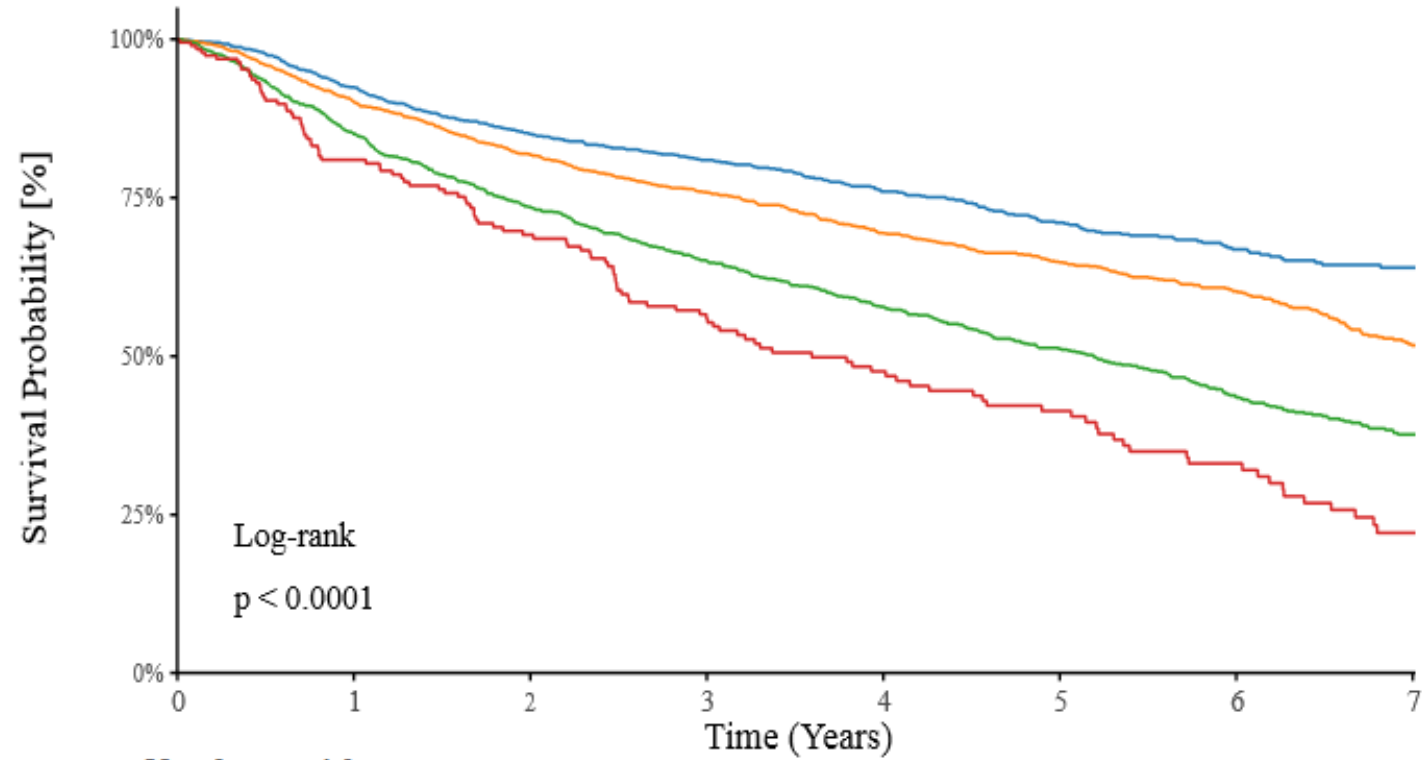
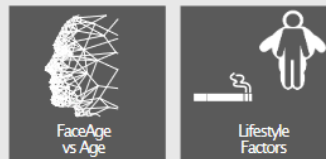
Training Dataset | IMDB-WIKI

- 56,304 famous and healthy individual
- Manually curated and focused on older individuals

Technical Validation | UTK

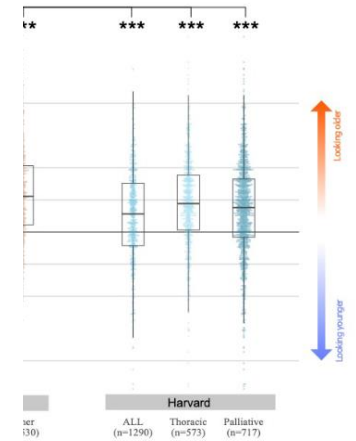
- 2,547 healthy individuals with matched ages and ethnicity labels

c | Clinical Experiments



Number at risk

FaceAge ≤ 65	1385	1067	861	700	536	409	250	128
65 < FaceAge ≤ 75	2035	1565	1300	1062	815	634	419	228
75 < FaceAge ≤ 85	1292	983	791	628	487	377	259	153
FaceAge > 85	194	143	114	88	64	49	32	17



- Plek van AI in een waarde-gedreven, lerend zorgsysteem
 - Welke proces kunnen we automatiseren, efficiënter, leuker maken?
 - Welke interventie leidt tot de beste uitkomsten voor een individu?
- Trends
 - FAIR Federatieve Data Infra
 - Deep Learning & Transformers
 - AI voor automatisering van “routine” taken
 - Companion AI voor indicatiesstelling en advies
- Uitdagingen
 - Balans tussen gevaren versus de waarde van data delen – “Data redden levens”
 - Data volwassenheid
 - Transparantie | Bias | Fouten & verantwoordelijkheid | Causaliteit | Cultuur | Kwaliteit | Ethiek

Waar moet ik me op richten? Wat heb ik nodig? Waar moet ik me op voorbereiden?

- Data is core business?
- Expertise in data (en dat is wat anders dan IT)
- Klinisch informaticus / Klinisch Fysicus / Data architect | engineer
| scientist / Chief Data Officer
- Data strategie
 - Onze organisatie is data gedreven
 - Data wordt doelmatig vastgelegd en gebruikt
 - Data wordt eenmalig vastgelegd en meermaals gebruikt
 - Data is onder controle
 - Data komt samen, stroomt en is waardevol
 - Medewerkers en patiënten worden zo min mogelijk belast met het vastleggen van data
 - Patiënten en medewerkers hebben vertrouwen dat data verantwoord wordt gebruikt
 - Data worden gewaardeerd

Data and analytics to become 'core business function' in 2021: Gartner

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	<i>Onderzoek, medisch managementinformatie & kwaliteitsregistraties (secundair gebruik / hergebruik)</i>	<i>9</i>
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Netherlands

- MAASTRO, Maastricht, Netherlands
- Radboudumc, Nijmegen, Netherlands
- Erasmus MC, Rotterdam, Netherlands
- Leiden UMC, Leiden, Netherlands
- Elizabeth Twee Steden Ziekenhuis, Tilburg, Netherlands
- Catharina Hospital, Eindhoven, Netherlands
- Isala Hospital, Zwolle, Netherlands
- NKI Amsterdam, Netherlands
- UMCG, Groningen, Netherlands
- IKNL, Utrecht, Netherlands

Europe

- Policlinico Gemelli & UCSC, Roma, Italy
- UH Ghent, Belgium
- UZ Leuven, Belgium
- Cardiff University & Velindre CC, Cardiff, UK
- CHU Liege, Belgium
- Uniklinikum Aachen, Germany
- LOC Genk/Hasselt, Belgium
- The Christie, Manchester, UK
- State Hospital, Rovigo, Italy
- St James Institute of Oncology, Leeds, UK
- U of Southern Denmark, Odense, Denmark
- Greater Poland Cancer Center, Poznan, Poland
- Oslo University Hospital, Oslo, Norway
- Aarhus Universitetshospital, Aarhus, Denmark
- Bank of Cyprus Oncology Center, Nicosia, Cyprus
- Weston Park Hospital, Sheffield, UK
- Hull University Teaching Hospitals NHS Trust, Hull, UK
- Addenbrookes' Hospital, Cambridge, UK
- Oxford University Hospitals NHS Foundation Trust, Oxford, UK
- Haukeland University Hospital, Bergen, Norway

Africa

- University of the Free State, Bloemfontein, South Africa

Asia

- Fudan Cancer Center, Shanghai, China
- CDAC, Pune, India

- Tata Memorial, Mumbai, India
- Suining Central Hospital, Suining, China
- HGC Oncology, Bangalore, India
- MVRCC&NITC, Calicut, Kerala, India
- Apollo Hospitals, Hyderabad, India
- CMC Vellore, Vellore, India
- Tianjin Medical University, Tianjin, China
- Cancer Hospital of Shantou University, Shantou, China
- Guangdong Provincial People's Hospital, Guangzhou, China
- Zhejiang Cancer Hospital, Hangzhou, China

North America

- RTOG, Philadelphia, PA, USA
- MGH, BWH, Harvard, Boston, MA, USA
- University of Michigan, Ann Arbor, USA
- Princess Margaret CC, Canada
- Ottawa Hospital Research Institute, Ottawa, Canada

South America

- Albert Einstein, Sao Paulo, Brazil

Australia

- University of Sydney, Australia
- Westmead Hospital, Sydney, Australia
- Liverpool and Macarthur CC, Australia
- ICCC, Wollongong Australia
- Calvary Mater, Newcastle, Australia
- North Coast Cancer Institute, Coffs Harbour, Australia

Industry

- Varian, Palo Alto, CA, USA
- Philips, Bangalore, India
- Sohord GmbH, Fuerth, Germany
- Microsoft, Hyderabad, India
- Mirada Medical, Oxford, UK
- CZ Health Insurance, Tilburg, NL
- Siemens, Malvern, PA, USA
- Roche, Woerden, NL
- IQVIA, London, UK

