AI in outcome and toxicity prediction

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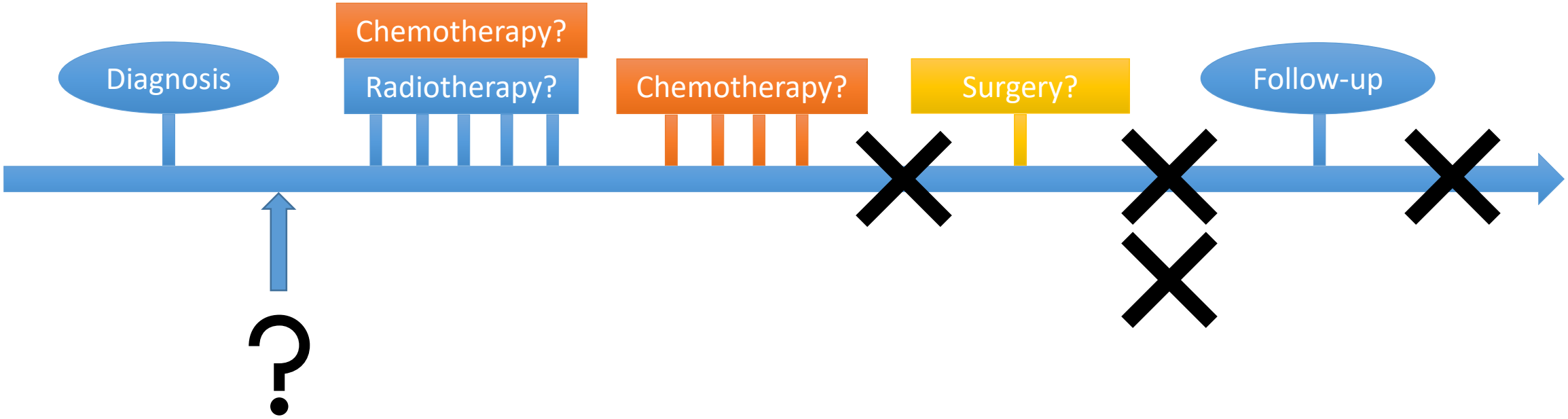
Outcome (and toxicity) prediction



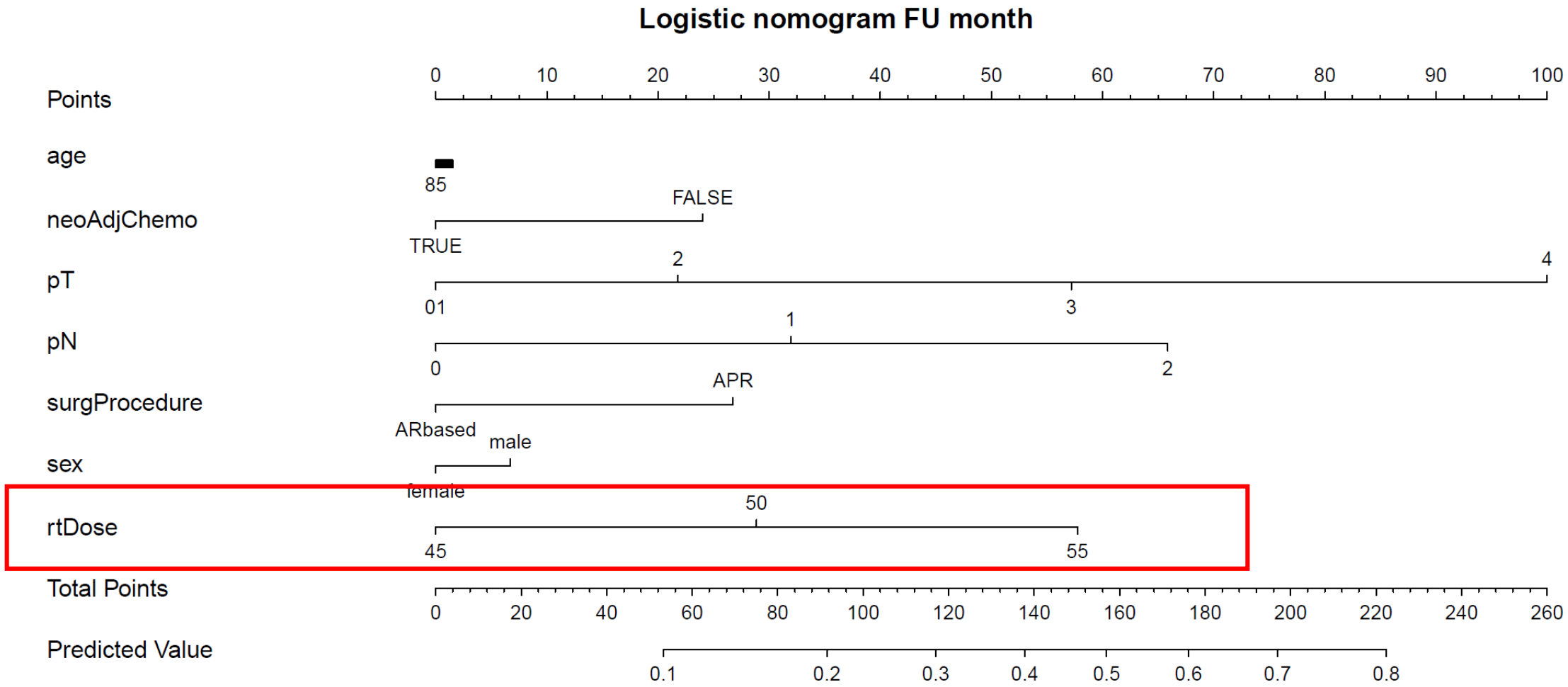
Model learning on clinical trials

- Models predicting LR, DM or OS
- (neo-)adjuvant chemo given?
  - Neo-adjuvant to what?
- “Trial arm indicates chemotherapy type”
  - Encoded as “1” and “2”
  - Size of trial arm is not equal to published paper

Trial	#pts
EORTC22921	1011
FFCD 2903	742
CAO/ARO/AIO 94	799
Polish I	312
ACCORD	598
Dutch TME	1731
Swedish trial	908
I-CNR-RT	634
Glynne-Jones cohort	113
INTERACT	538
CAO/ARO/AIO 04	1236
TROG 01-04	323
Polish II	515
Nordic trial	207
Total:	**9667**

Valentini et al. In submission

Model learning on clinical trials



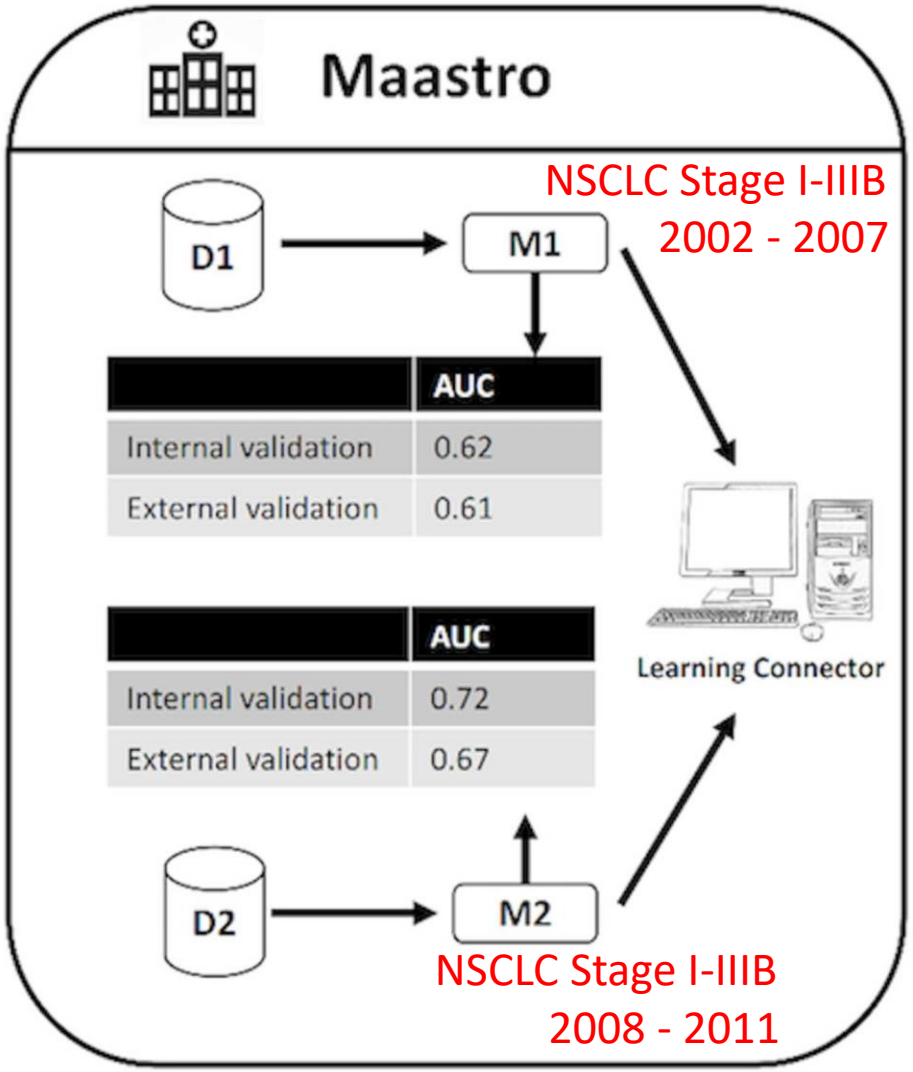
Valentini et al. In submission

Model learning on clinical trials

- Interactions on variables are important
  - Hypothesis: Influenced by inclusion criteria of trials
  - Only in text of manuscript, not noted in actual (meta) data

- Hence, context of outcome prediction models are important!
  - E.g. treatment guidelines / protocols

Model learning for treatment toxicity



Variable	Model coefficients (M1)	Model coefficients (M2)
Intercept	−2.2767	−1.512
PERFORMANCE STATUS		
WHO-PS = 1	0.28	–
WHO-PS ≥ 2	0.57	–
Current smoker	−0.45	–
Age	0.02	–
Mean lung dose	0.05	–
Baseline dyspnea	–	0.990
Cardiac comorbidity	–	0.826
Sequential chemotherapy	–	0.610
Tumor in middle/lower lung lobe	–	−0.290
Baseline FEV_1	−0.02	−0.007

Shi et al. Front Oncol 2019;9.

Model assessment

- “Standard” model performance measures
  - Discrimination (C-index / AUC)
  - Calibration (in-the-large & slope & plot)
  - Accuracy / F-score / PPV / NPV and associated curves

- But what if a model doesn’t work?

Assess cohort differences / similarity

id	cT	cN	ECOG	2y_mort	Cohort
1	3	1	1	Y	Train
2	2	0	2	N	Train
3	3a	9	1	N	Train
id	cT	cN	ECOG	2y_mort	Cohort
4	1	NA	3	N	Test
5	4	2	4	Y	Test
6	2b	0	3	Y	Test

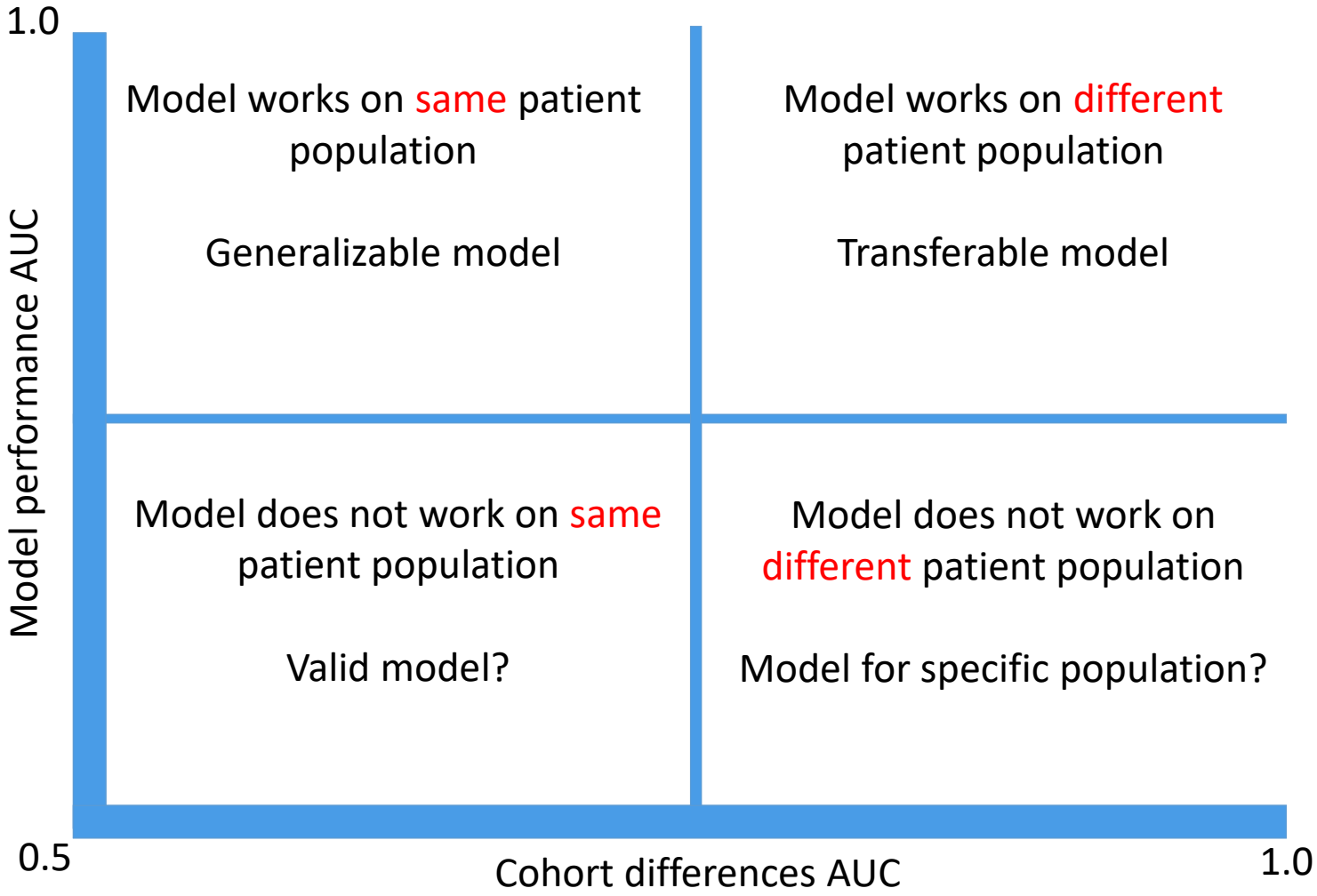
Input variables Predicted

Can we predict whether a patient belongs to the training or test cohort?

Yes (high AUC): cohorts are different
No (AUC ~0.5): cohorts are similar

van Soest et al. Med Phys 2017;44:4961–7

Model assessment & cohort differences



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Clinical Use?

- Do you have all variables available?
- Does it work on “my” patients?
- When is good, good enough?
- Continuous monitoring?

- ……. Needs “commissioning” and continuous QA of models

Thank you

Netherlands
- MAASTRO, Maastricht, Netherlands
- Radboudumc, Nijmegen, Netherlands
- Erasmus MC, Rotterdam, Netherlands
- Leiden UMC, Leiden, Netherlands
- Catharina Hospital, Eindhoven, Netherlands
- Isala Hospital, Zwolle, Netherlands
- NKI Amsterdam, The Netherlands
- UMCG, Groningen, 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

Africa
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- Suining Central Hospital, Suining, China
- CDAC, Pune, India
- Tata Memorial, Mumbai, India
- HGC Oncology, Bangalore, India
- Apollo Hospitals, Chennai, India

North America
- RTOG, Philadelphia, PA, USA
- MGH, Boston, MA, USA
- University of Michigan, Ann Arbor, USA
- Princess Margaret CC, 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 Research, Bangalore, India
- SoHard GmbH, Fuerth, Germany
- Microsoft, Hyderabad, India
- Mirada Medical, Oxford, UK
- CZ Health Insurance, Tilburg, NL
- Siemens, Malvern, PA, USA
- Roche, Woerden, NL
- Medical Data Works, Heerlen, NL

Research funding
- STW-Perspectief (duCAT, STRaTegy)
- EUREKA Eurostars (SeDI, CloudAtlas, DART, DECIDE)
- Dutch Research Council (CARRIER, BIONIC, TRAIN, ELIXIR)
- Care Institute Netherlands (PROSPECT)
- Queen Wilhelmina Foundation (PROTRaIT, HealthRI)
- National Institutes of Health (RADIOMICS)