



# AI in een niet-academisch instituut

Ervaringen vanuit Radiotherapiegroep Arnhem/Deventer

28 maart 2024 Eindhoven

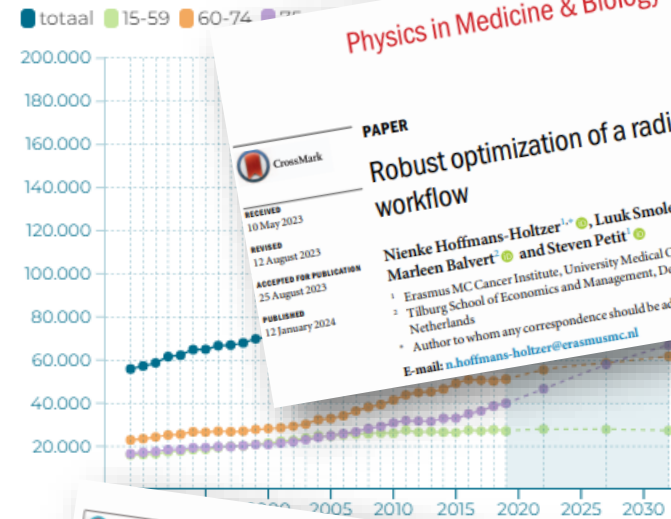
# Inleiding

## 2024 en verder ...

- Vergrijzing populatie
- Toenemende kanker incidentie
- 60% van kankerpatienten krijgt RT
  
- Personeelstekort
- Toenemende complexiteit RT
- Optimalisatie werkproces

Toepassing van AI binnen de radiotherapie

## Alle vormen van kanker tezamen incidentie naar leeftijdsgroep



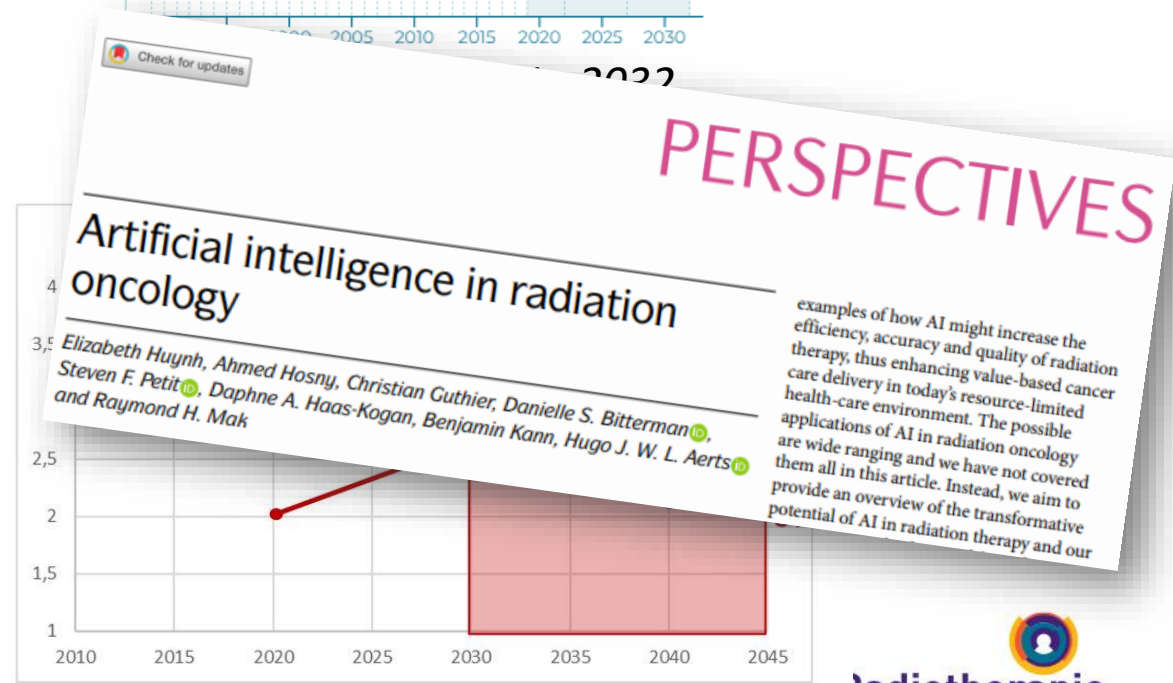
### Physics in Medicine & Biology

#### PAPER Robust optimization of a radiotherapy pretreatment preparation workflow

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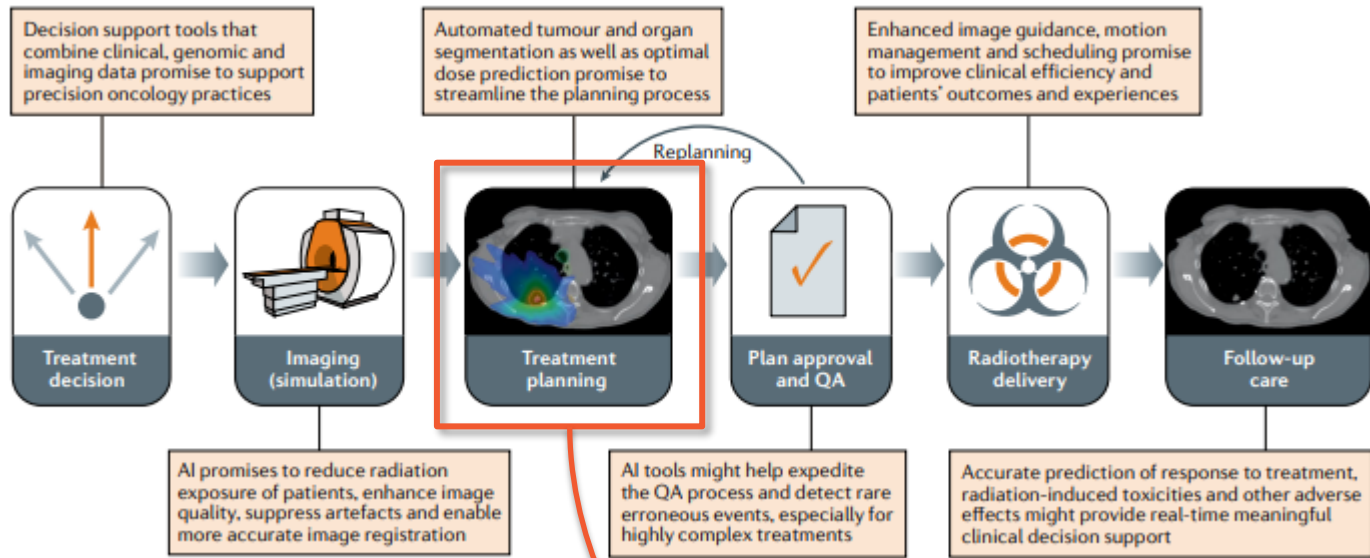
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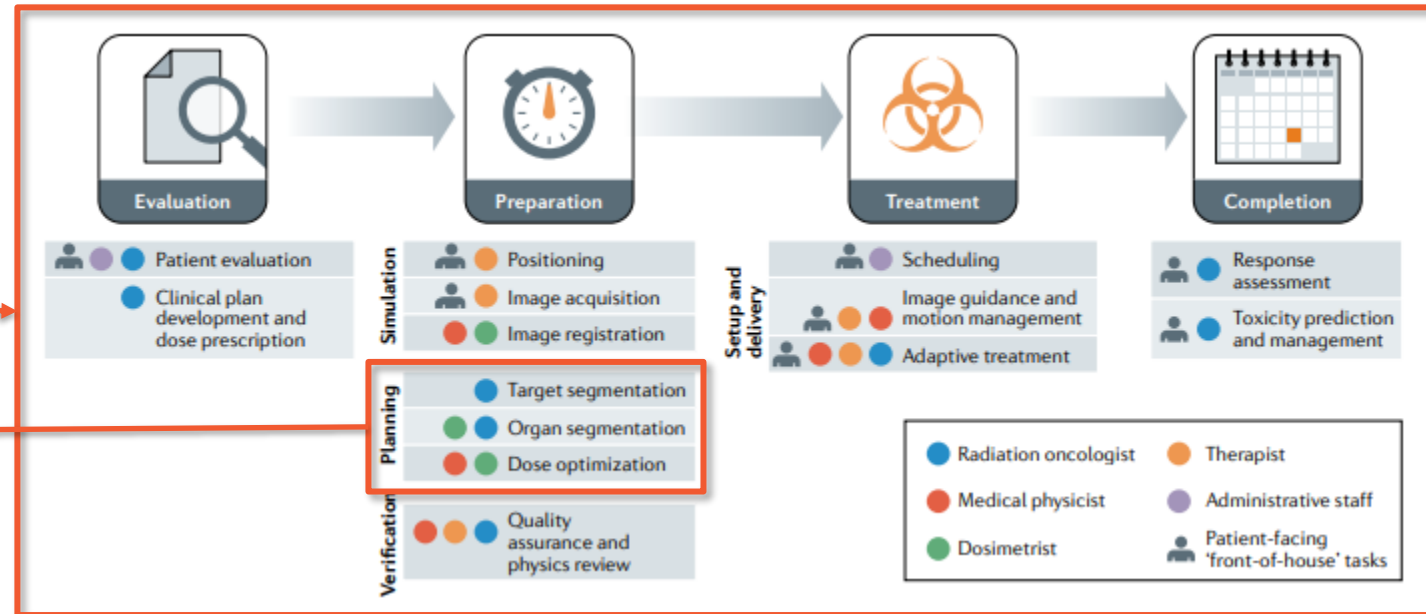
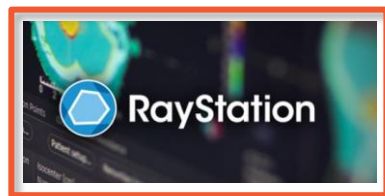


Figuur van S. Petit, ErasmusMC

# RT Workflow



Huynh et al. Nature Reviews Clinical Oncology 2020



# Op weg naar klinische acceptatie

## Enquête onder laboranten die OARs intekenen

#Stellingen 17 respondenten



Welke ROIs kosten veel tijd



Welke ROIs zijn moeilijk om in te tekenen



HeadNeck CT  
MR gerelateerd

# Impact

## Schatting op basis van de interne enquête

		Mean time						
		Manual Institution	Correction Mirada	Correction MVision	Correction Radformation	Correction RayStation	Correction Therapanacea	
Breast	No. structures	10	8	8	10	5	10	
	Time for 10 structures [min]	22	25	7.5	1.6	7.8	3.1	1.4
	Saving [min/%]		14.5/66.0%	20.4/92.8%	14.2/64.4%	18.9/86.0%	20.6/93.7%	
Head and neck	No. structures	19	27	27	27	26	30	
	Time for 19 structures [min]	97	85	3.2	9.8	22.7	4.6	4.4
	Saving [min/%]		88.8/91.6%	87.2/89.9%	74.3/76.6%	92.4/95.3%	92.6/95.4%	
Lung	No. structures	6	6	6	6	5	6	
	Time for 6 structures [min]	26	30	5.2	1.2	6.0	1.5	0.4
	Saving [min/%]		20.8/80.1%	24.9/95.6%	20.0/76.8%	24.5/94.4%	25.6/98.4%	
Prostate	No. structures	10	8	9	9	5	10	
	Time for 10 structures [min]	42	45	7.4	0.3	4.3	5.2	0.1
	Saving [min/%]		34.6/82.3%	41.7/99.3%	37.7/89.7%	36.8/87.6%	41.9/99.7%	

*Doolan et al. Front Oncol 2023 – results from April 2022*

Potentiëel 90% time-saving door AI auto-contouring

*“Autosegmentation-based solutions have been shown to reduce overall contouring time by 20% to 40% compared with manual segmentation”*

REVIEW: Automated Contouring and Planning in Radiation Therapy: What Is ‘Clinically Acceptable’?  
Hana Baroudi, Kristy Brock, et al. 2023

# RTG workflow

## Ingrediënten voor AI toepassing RTG

- Geen machine learning team beschikbaar
- Innovation team – MBB, KF, RT
  - Dedicated tijd voor innovatie
- Research collaboration with RaySearch Labs
  - O.a. gericht op AI applicaties
- Gestructureerde data
  - Voor automatische segmentatie
  - Voor bestralingsplanning

Althans.. dat is wat we dachten ...



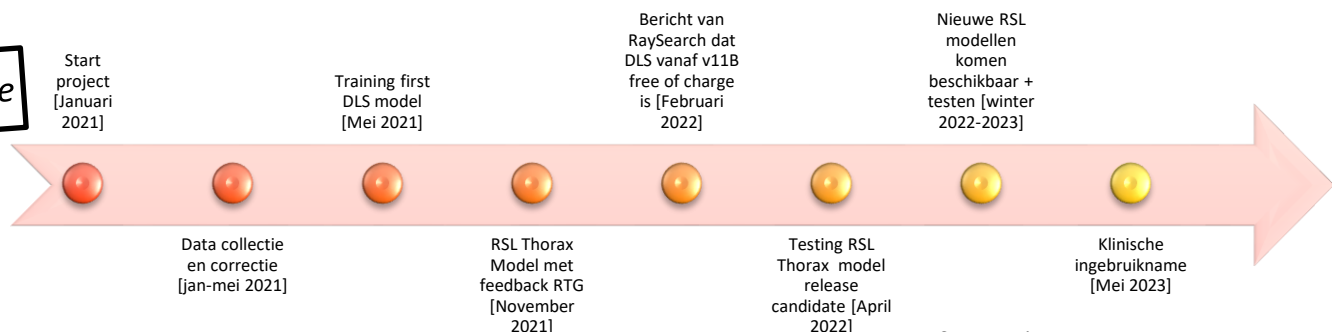


# Deep learning segmentatie

## DSL modellen voor CT en MR

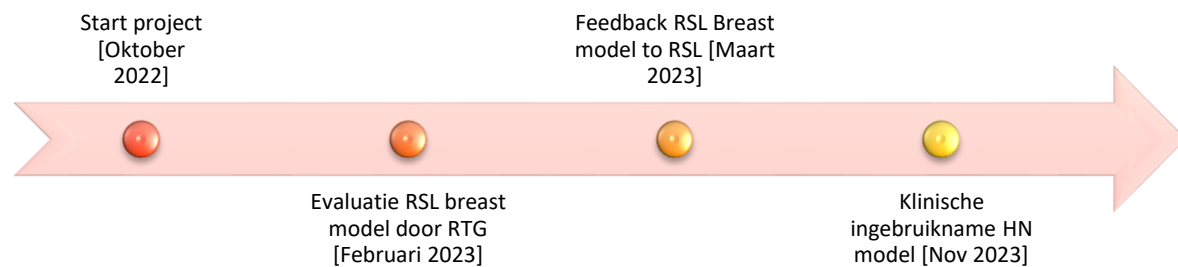
**Ontwikkeling en implementatie**

Thorax & Pelvic  
male CT model



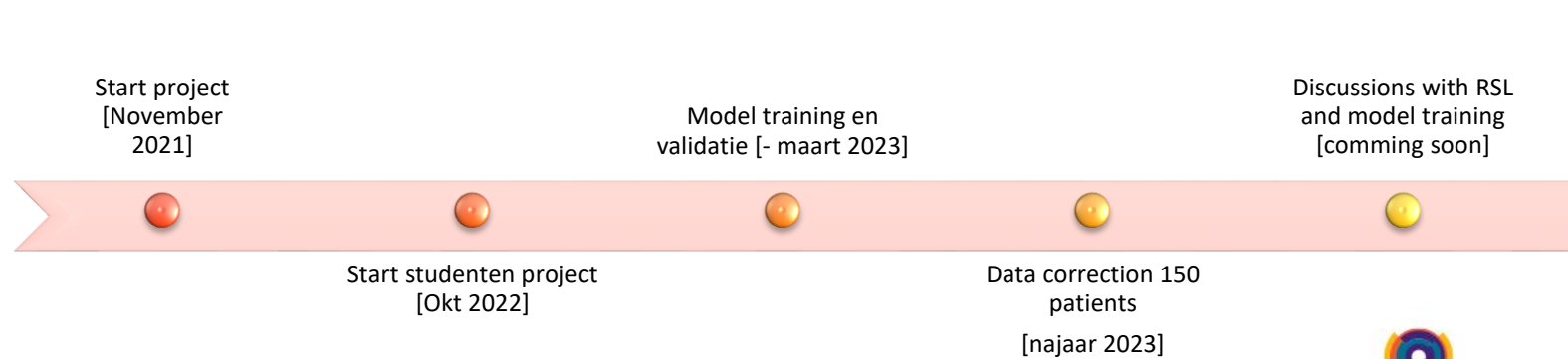
**Validatie en feedback**

Breasts & HN  
CT model

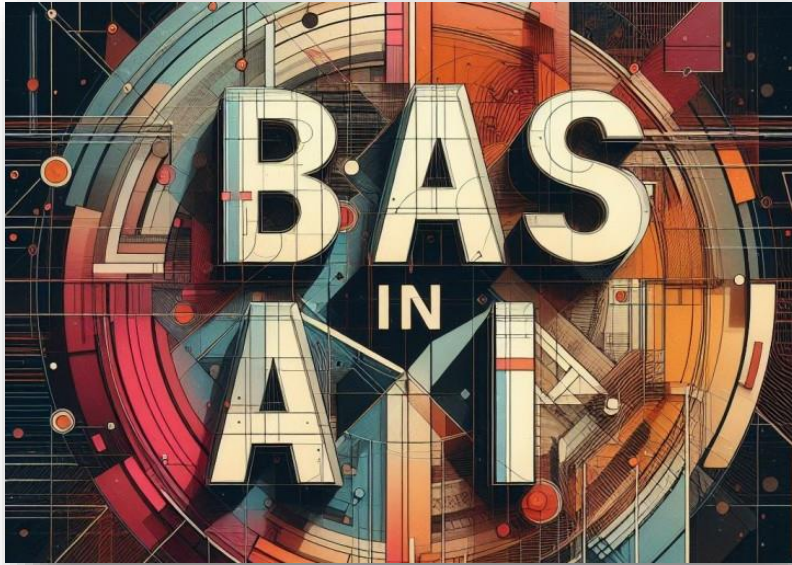


**Ontwikkeling en implementatie**

Pelvic male  
MR model



# Bias in AI



M. Gooding, LinkedIn 20 Maart 2024

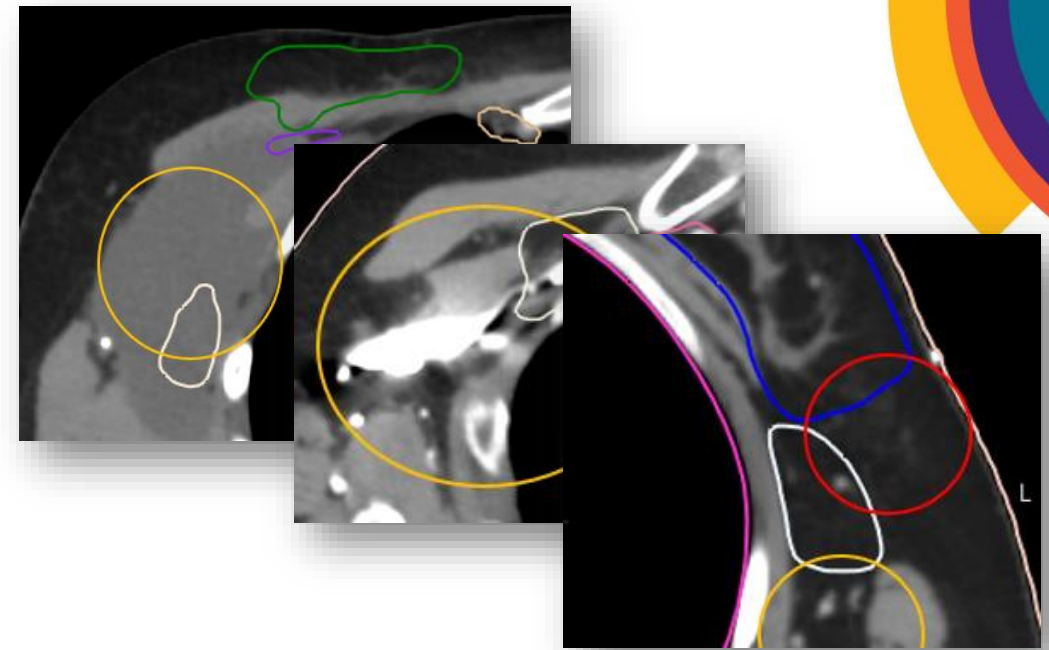
Mark: "For instance, does the economic background of the patient carry any subtly into how they appear in imaging? I don't expect healthcare AI vendors to be looking into every possible factor - it's just not possible to test everything. However, they should be investigating the obvious ones"

## Feedback

Vendor: geef details over de training set

Kliniek: observeer de bias

8 26-03-2024 AI binnen RTG



Reacties van de radiotherapeut:

*"Postoperatief met seroom en clips is lastig voor het algoritme"*

*"Distortie in de gebieden met hoge dichtheid zorgt voor fouten"*

*"model lijkt getraind op de markers, contour loopt niet ver genoeg door"*

## Preventie van "automation bias"

- Make users aware of AI reasoning process
- Emphasizing human accountability
- Presenting uncertainties of the AI output
- Training users of situation-specific reliability

REVIEW: Automated Contouring and Planning in Radiation Therapy: What Is 'Clinically Acceptable'?  
Hana Baroudi, Kristy Brock, et al. 2023



# Pelvic male DLS MR



D. Scheltes D. Haverkort M. Noordeloos M. Rasing

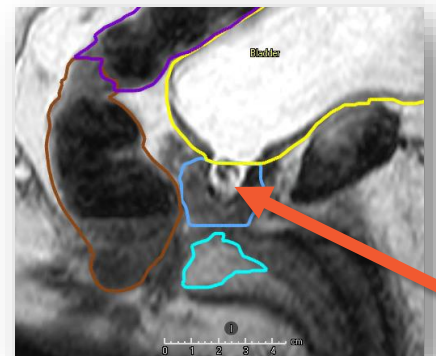
## Samenwerking RTG - RSL

### Fase 1. Verkenning middels project student

- 150 T2-weighted MR scans
- Protocol voor Unity MR-linac
- Segmentatie van prostaat, rectum, blaas, sigmoid, external
- Significante tijdwinst maar rectum DLS te krap (student-effect getraind)

### Fase 2. Eerste klinische DLS model op MR in RayStation

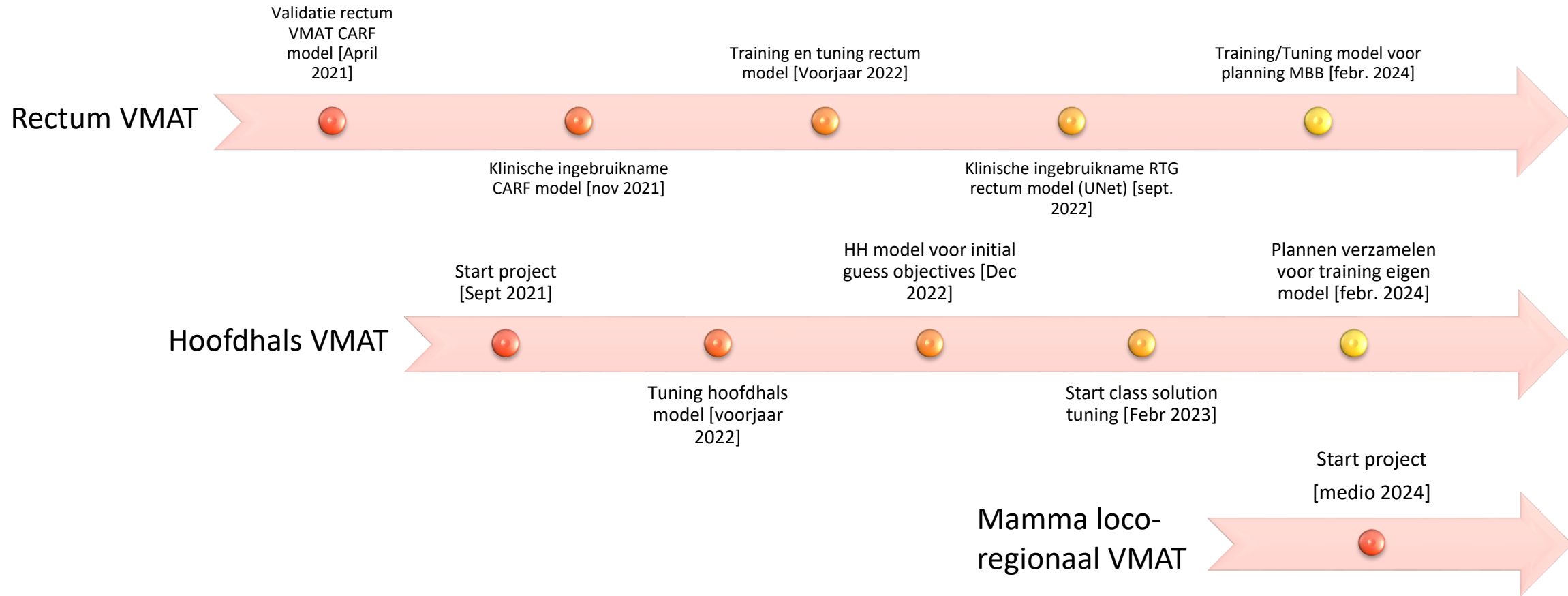
- Project door RO, CT en MR-linac MBB
- Extra:
  - Discussies over segmentatie, guidelines, etc.
  - Contour\_clinical != Contour\_trainingset
  - Participeren en acceptatie AI projecten



# Machine learning planning

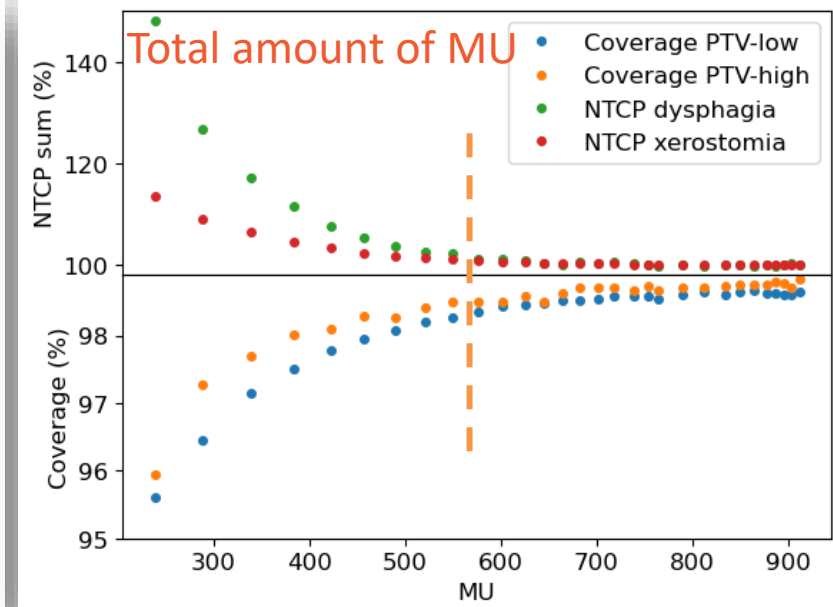
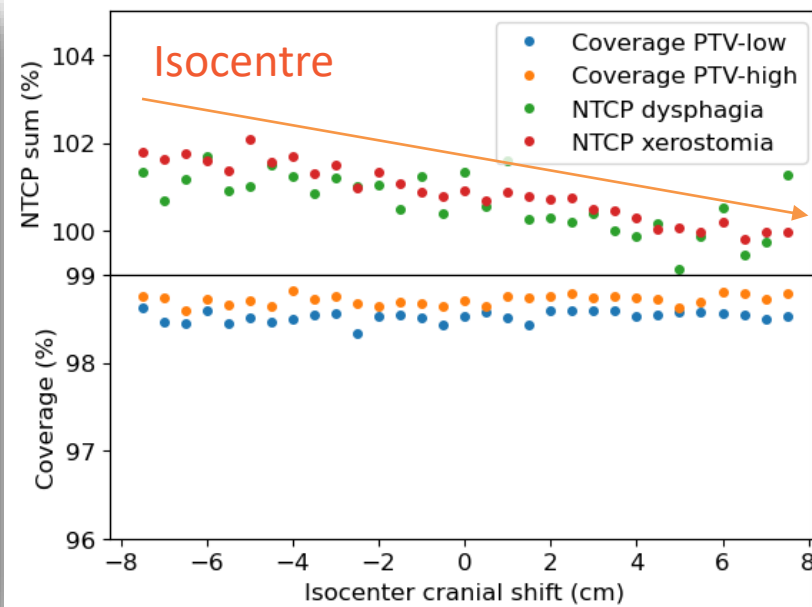
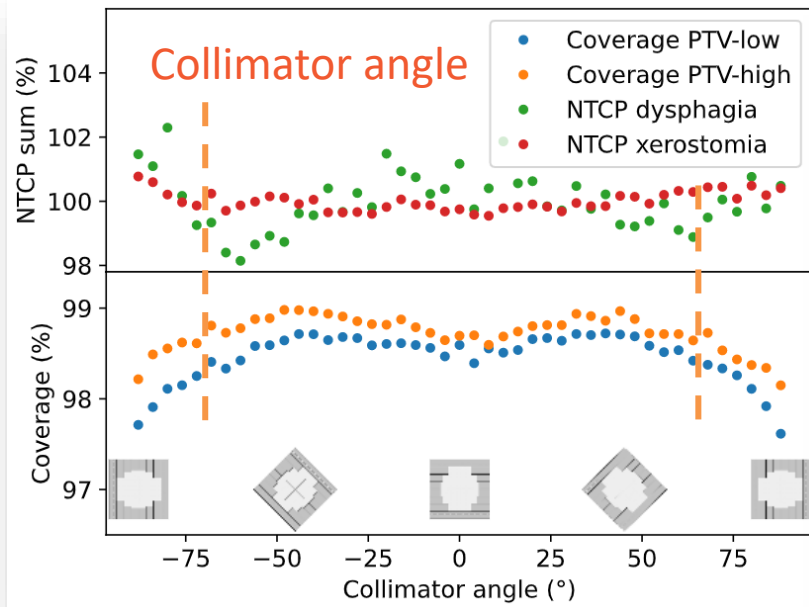


M. de Boer A. Arents E. van der Wal



# Tuning class solution

## Hoofdhals VMAT – target coverage en NTCP



# Conclusie

## AI in een niet-academische instituut

- AI heeft ook binnen RTG voet aan de grond gekregen en biedt vele mogelijkheden
- Toegepast door nauwe samenwerking met industrie (RaySearch Labs)
- Implementatie is tijdrovend maar betrek MBBers vroegtijdig in het proces