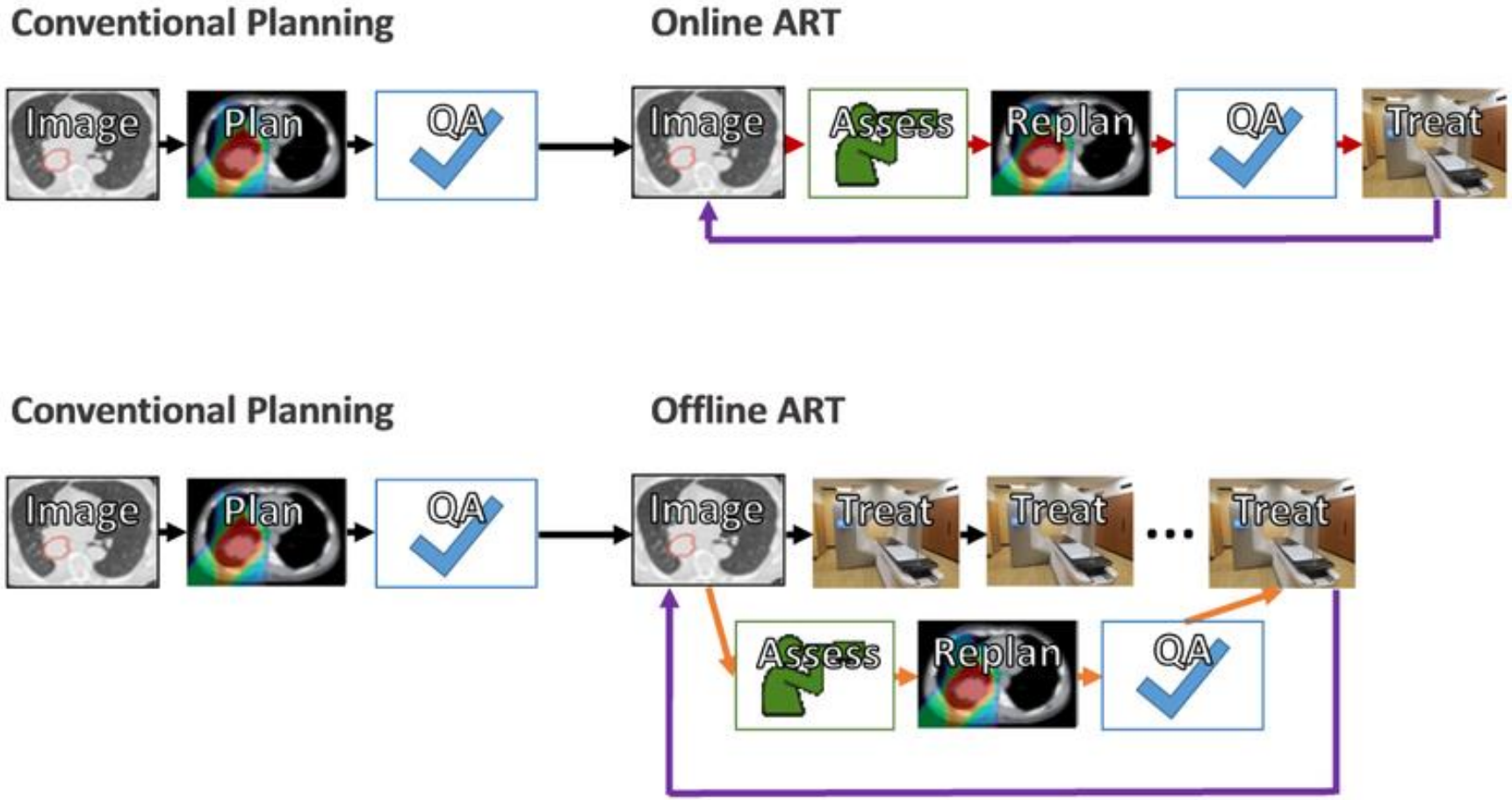
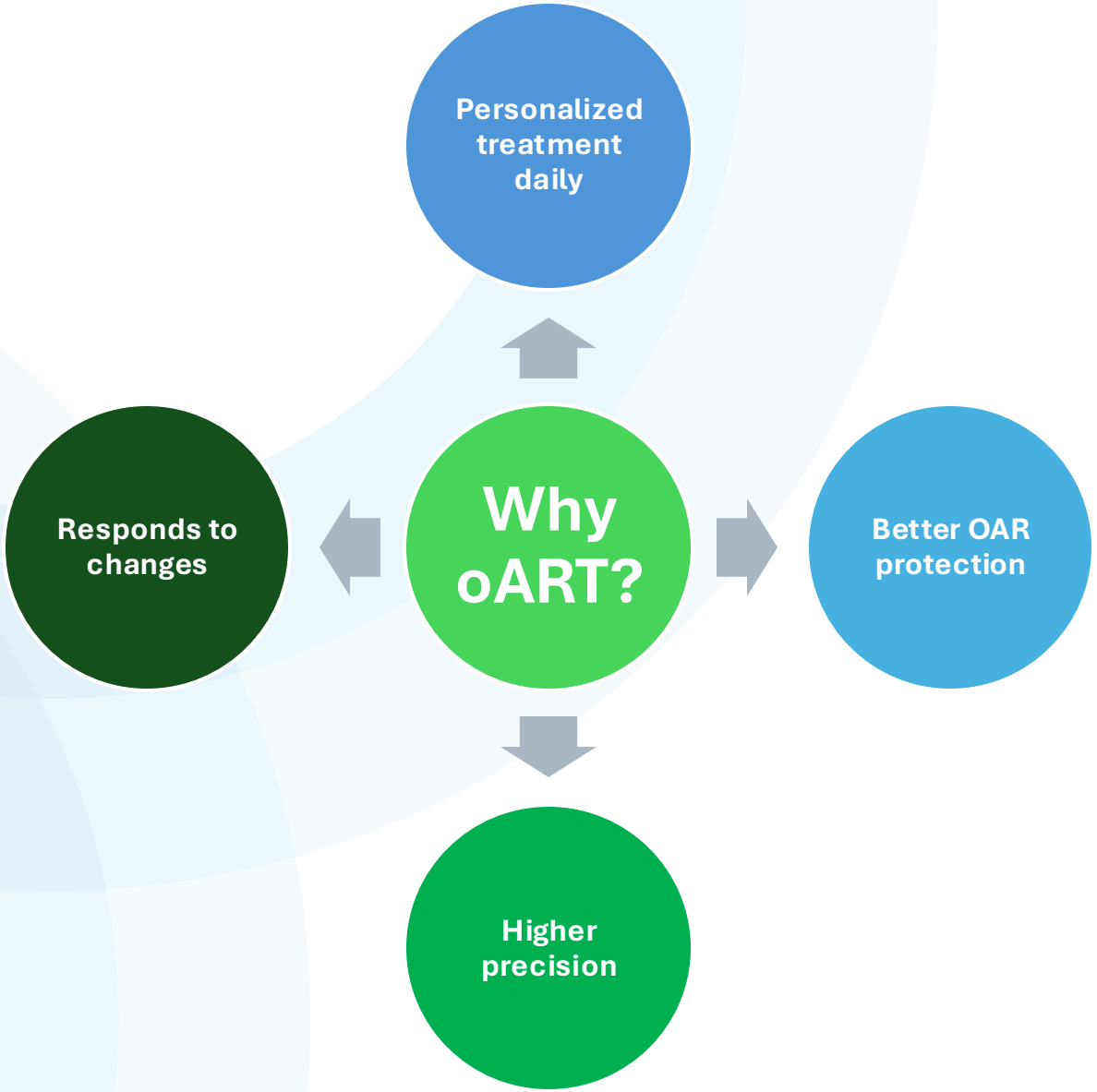
Benefits of InBore Intra-Fraction Monitoring during Adaptive RT

Aleksandar Kovačević

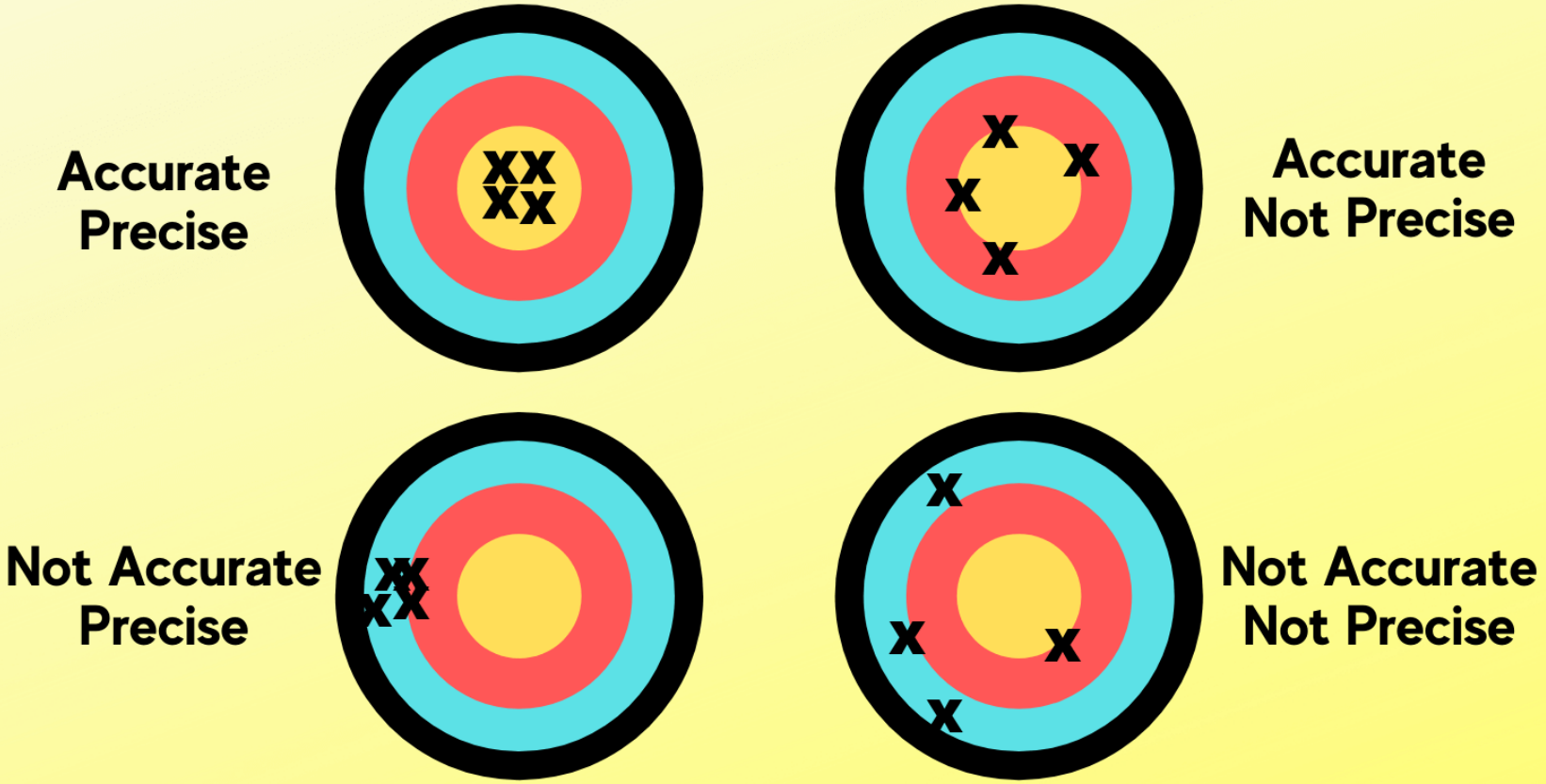
Specialty Hospital Radiochirurgia Zagreb

ADAPTIVE RT


Conventional Planning
Image
Plan
QA
Online ART
Image
Assess
Replan
QA
Treat
Conventional Planning
Image
Plan
QA
Offline ART
Image
Treat
Treat
...
Treat
Assess
Replan
QA


Personalized treatment daily
Responds to changes
Why oART?
Better OAR protection
Higher precision

Accuracy and Precision



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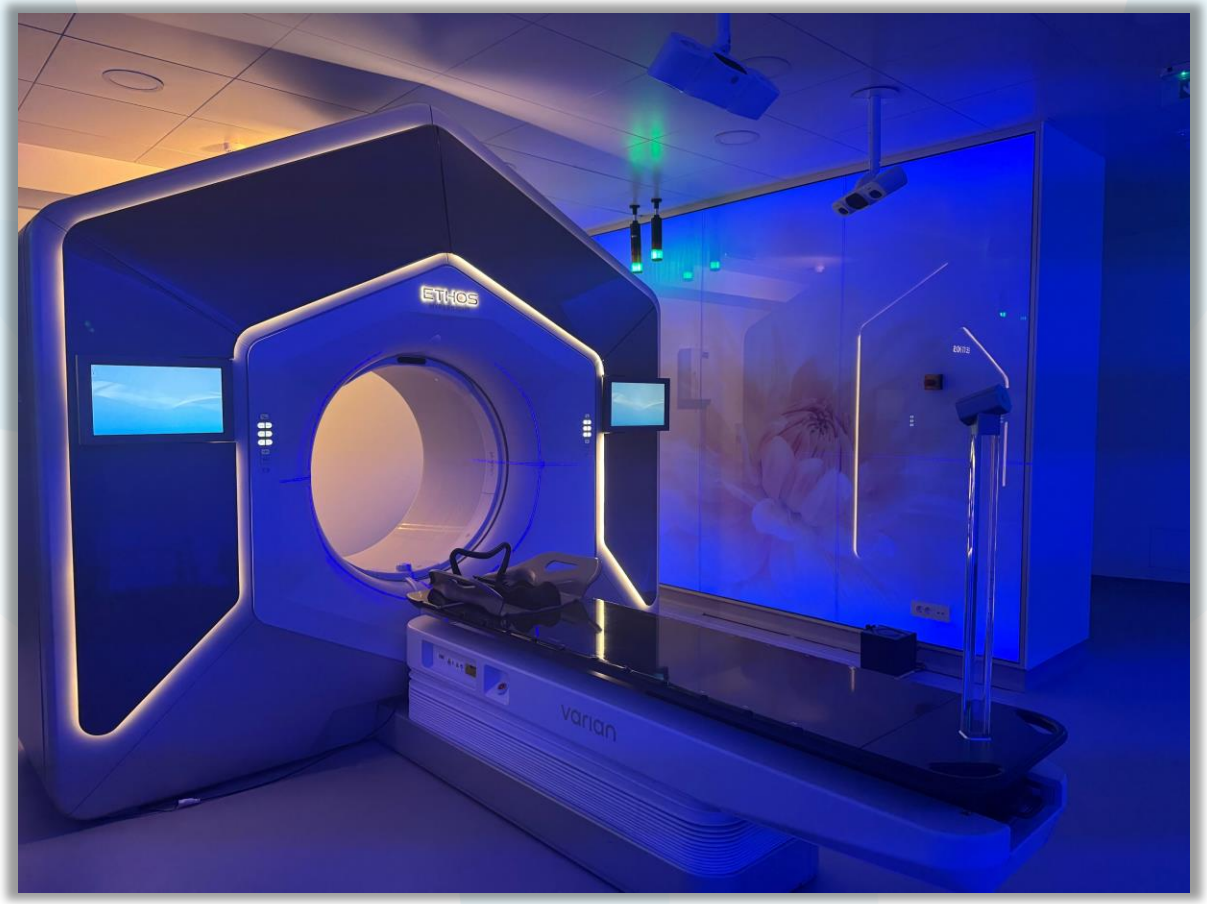
VARIAN ETHOS 2.0



- 6 MV FFF
- 28 MLC leaf pairs (5 mm)
- Maximum field size 28 x 28 cm^2
- Hypersight CBCT
- AlignRT InBore

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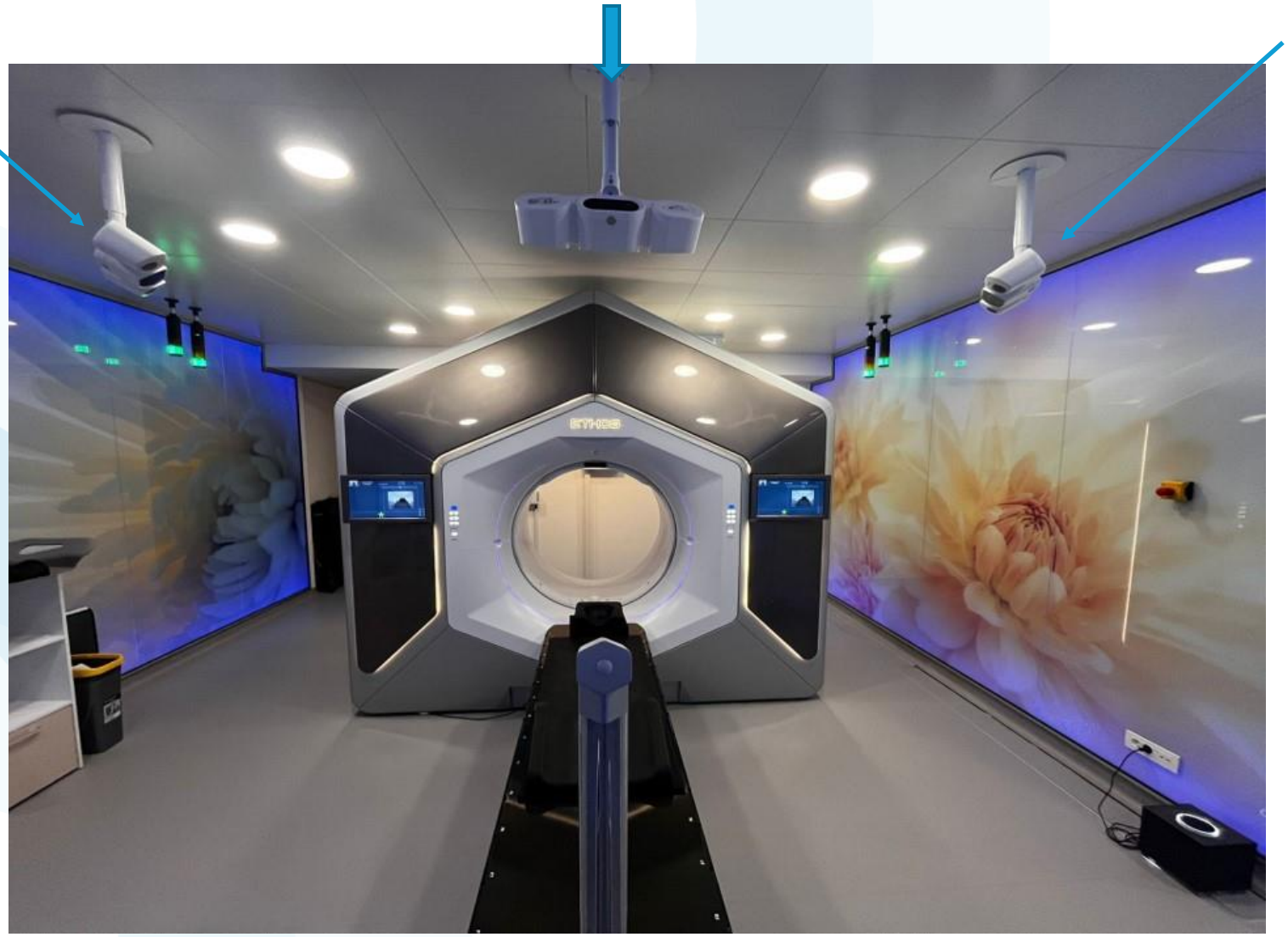

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ALIGNRT InBORE

- combines the benefits from ceiling-mounted cameras
- dual camera system mounted on a ring within bore
- full visibility of tracking region through **setup**, **imaging** and **treatment**

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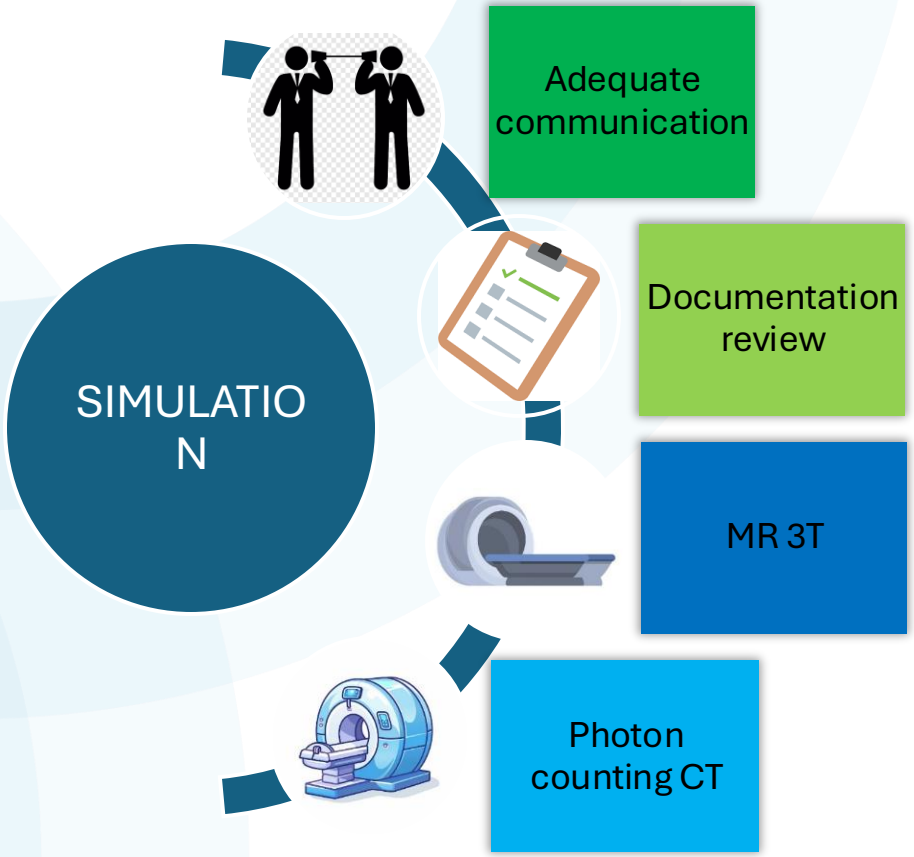
oART WORKFLOW IN OUR CLINIC



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Photon counting CT

- Contrast-rich images
- Higher spatial resolution
- Faster scan time
- Spectral postprocesing
- Lower dose
- QuantumPlus technology

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3T MRI

- Better soft tissue differentiation
- No ionizing irradiation
- Standard for SBRT

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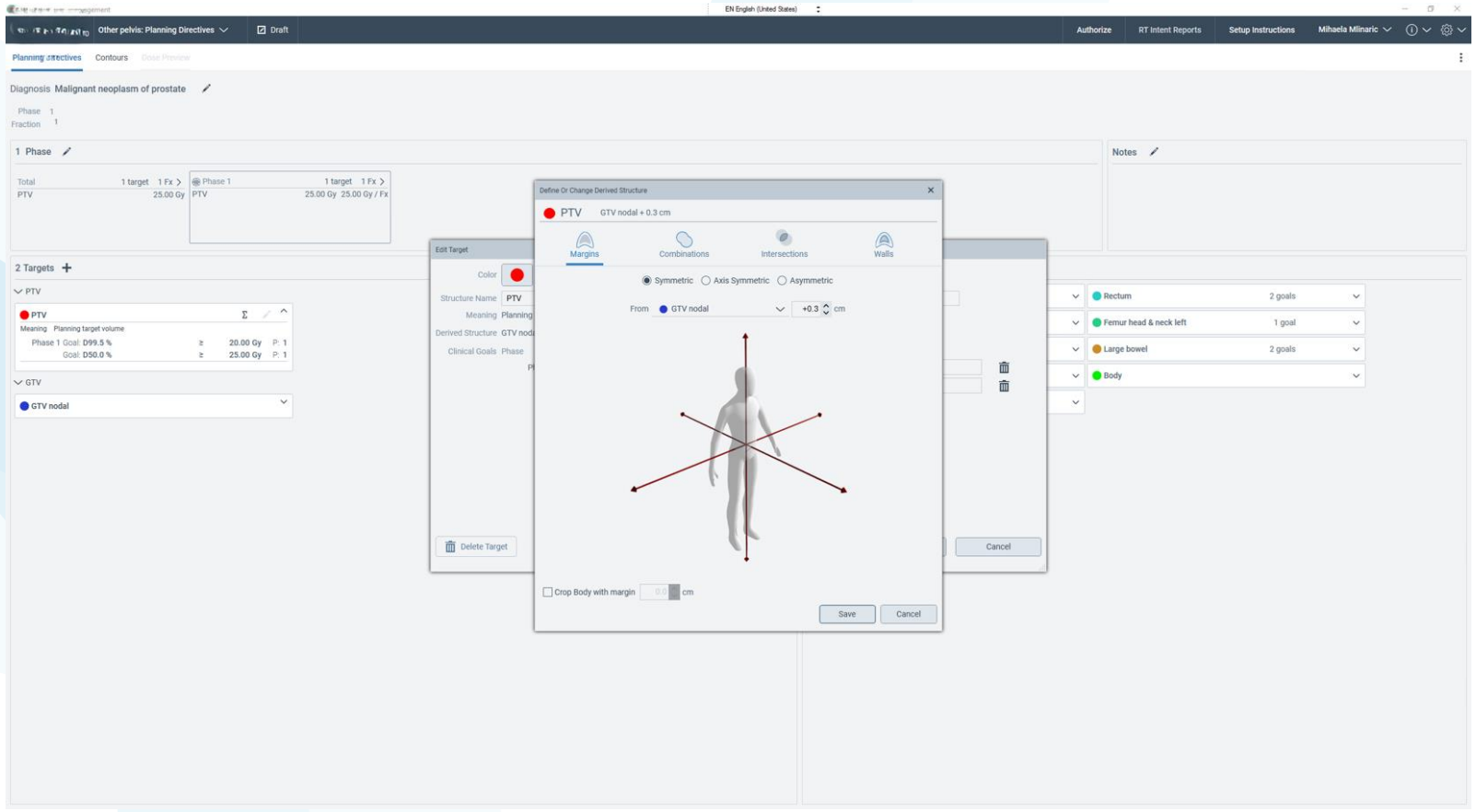
ETHOS TREATMENT PLANNING SYSTEM



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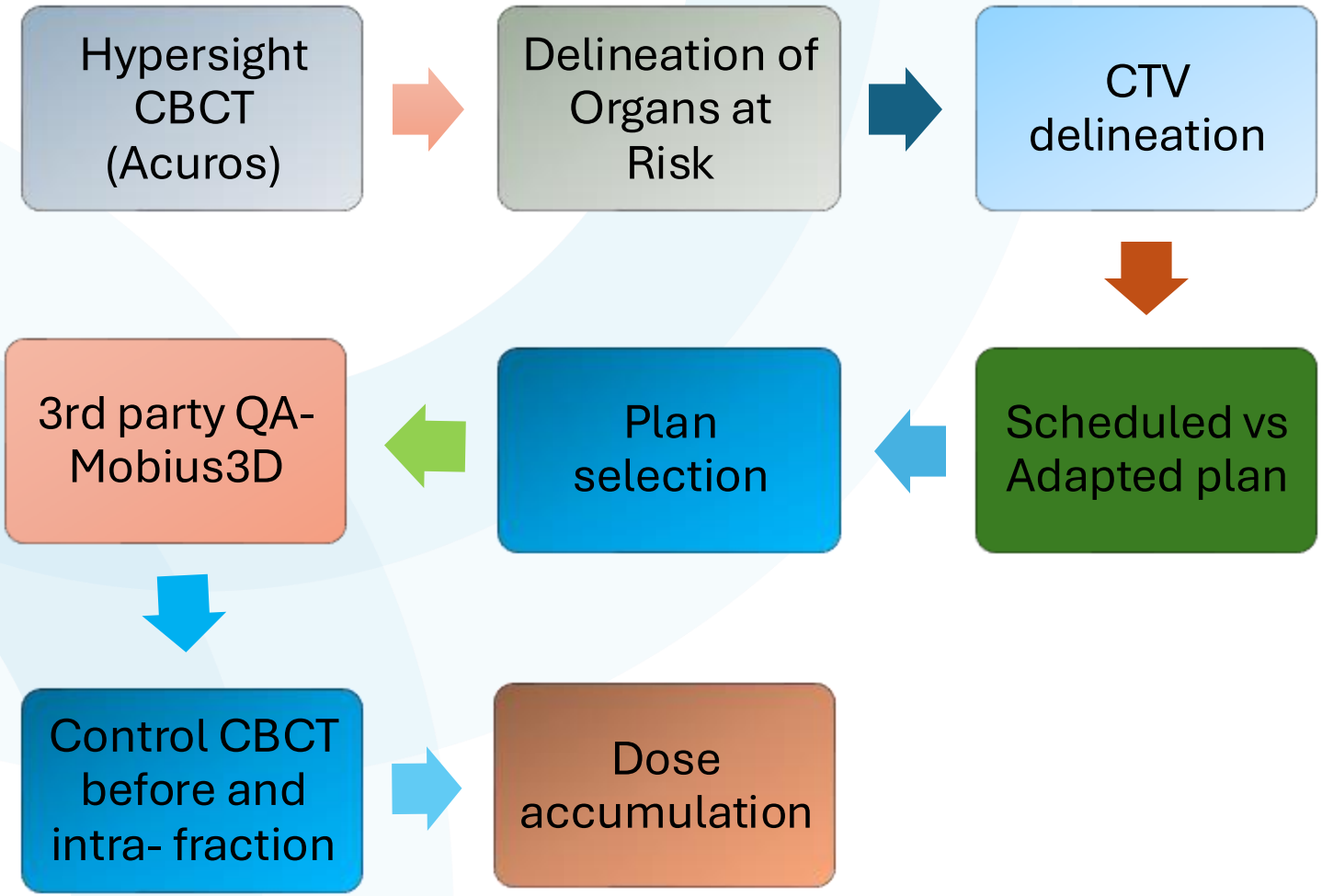
PATIENT SETUP

1. SETUP POSITION

2. TREATMENT POSITION


Hypersight CBCT (Acuros)
Delineation of Organs at Risk
CTV delineation
Scheduled vs Adapted plan
Plan selection
3rd party QA- Mobius3D
Control CBCT before and intra- fraction
Dose accumulation

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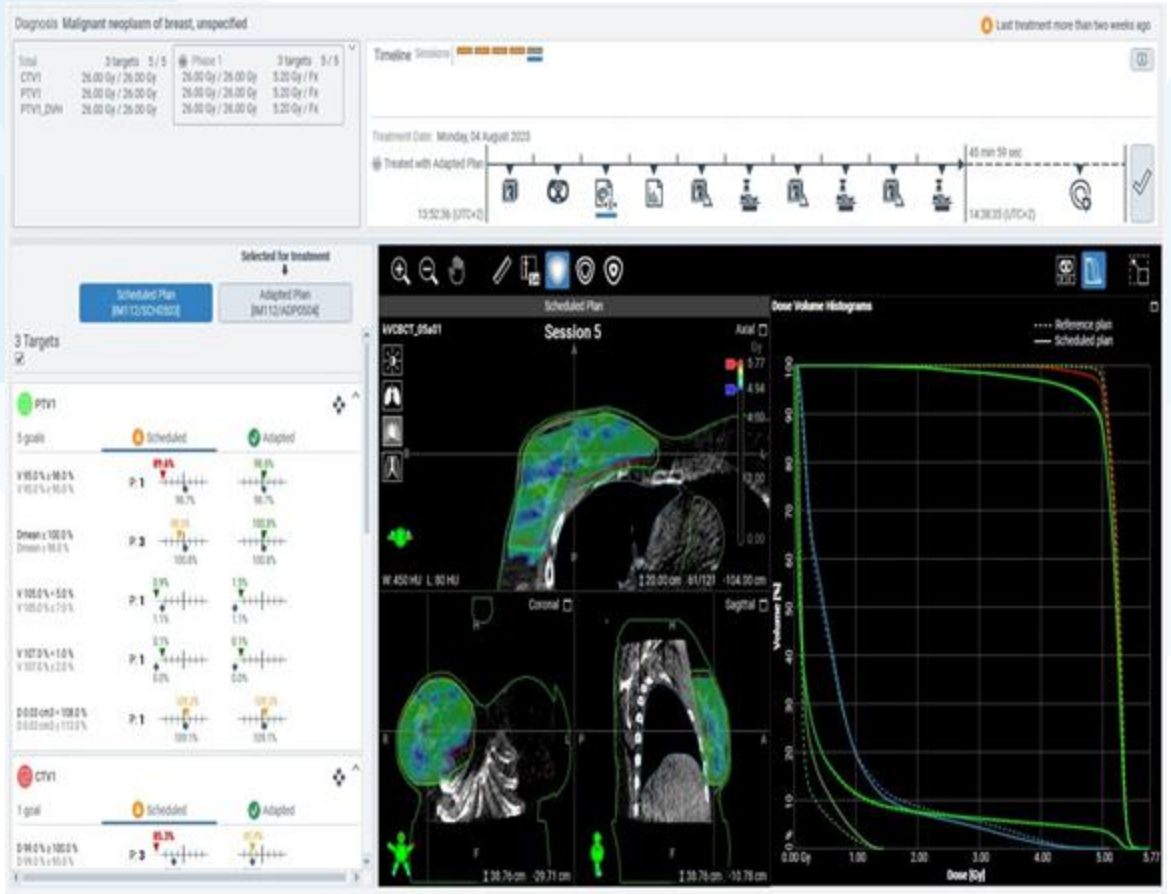
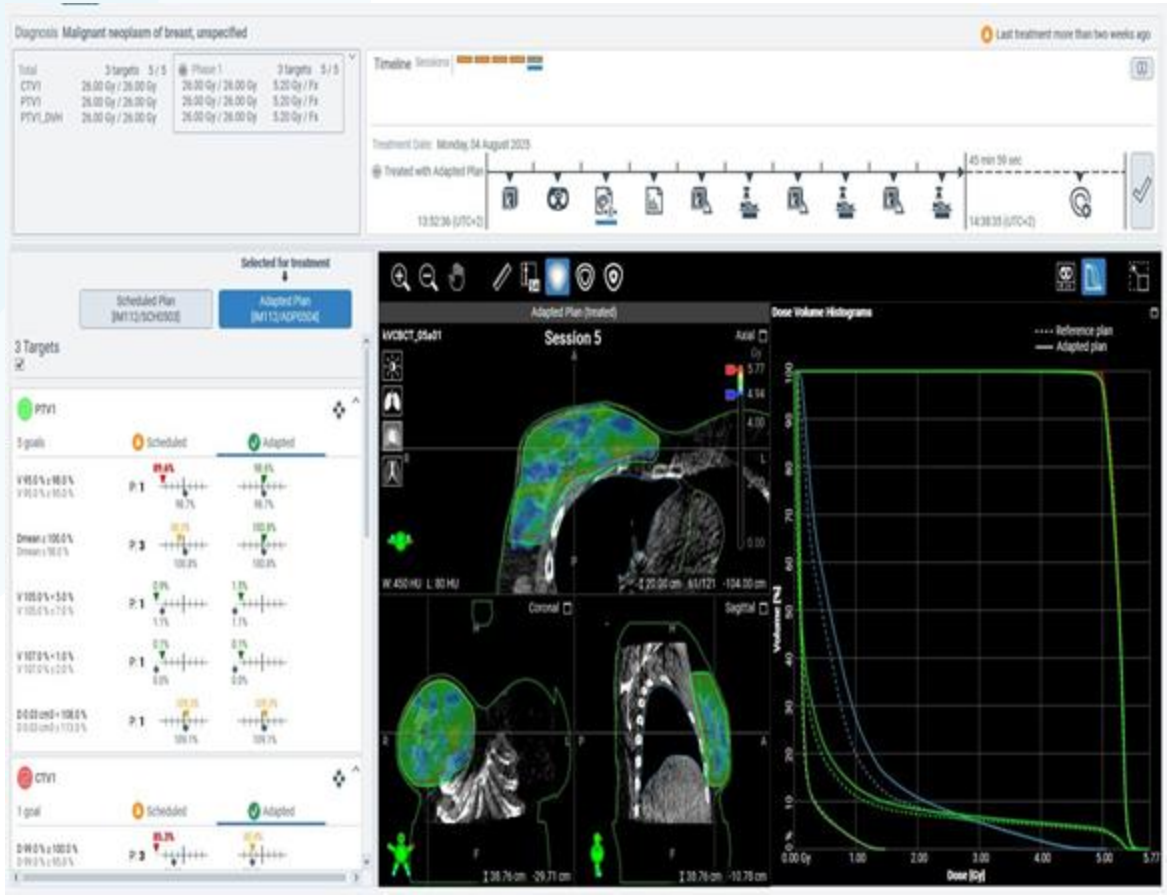
SCHEDULED vs. ADAPTED PLAN





CBCT-guided adaptive ultrahypofractionated whole-breast radiotherapy: a single-center early experience

Damir Vučinić [1], Hrvoje Kaučić [1], Giovanni Ursi [1], Matea Lekić [1], Aleksandar Kovačević [1], Domagoj Kosmina [1], Blanka Jakšić [1], Dragan Schwarz [1]

[1] Specialty Hospital Radiochirurgia Zagreb, 10431 Sveta Nedelja, Croatia

Objective

This study reports the implementation and early clinical experience of adaptive adjuvant whole-breast radiotherapy (ART) delivered using the Fast Forward hypofractionated regimen. The primary objective was to evaluate the feasibility, workflow efficiency, and clinical safety of the ART approach integrating daily CBCT-based plan adaptation with inspiration breath-hold (IBH).

	n (%)
Total patients	40 (100%)
Laterallity	
Right	27 (67.5%)
Left	13 (32.5%)
Molecular subtype	
Luminal A	13 (32.5%)
Luminal B	15 (37.5%)
HER2-positive	6 (15.0%)
Triple negative	6 (15.0%)
Histologic grade	
Grade I	9 (22.5%)
Grade II	24 (60%)
Grade III	7 (17.5%)
Ki-67 index	
< 21%	13 (32.5%)
21–50%	24 (60.0%)
> 50%	3 (7.5%)
Systemic therapy	
Neoadjuvant chemotherapy	5 (12.5%)
Adjuvant chemotherapy	14 (35.0%)
Hormonal therapy	34 (85.0%)
Radiotherapy regimen	
Fast Forward 26 Gy / 5 fractions	25 (62.5%)
Fast Forward 27 Gy / 5 fractions	15 (37.5%)
Pathological stage (pTNM)	
Tis	7 (17.5%)
T1	27 (67.5%)
T2	6 (15%)
T3	0 (0.0%)
N0	40 (100%)

Materials and Methods

A total of 40 patients treated between February 2024 and September 2025 with ART following breast-conserving surgery were analyzed. Patient positioning and respiratory motion management were achieved using an inspiration breath-hold (IBH) technique, with continuous surface guidance (AlignRT). Target volumes were delineated according to contemporary ESTRO consensus recommendations, with a 5 mm margin applied to create the planning target volume (PTV). An intensity-modulated radiation therapy (IMRT) plan was created based on the simulation scan as the reference plan, utilizing six megavolt flattening-filter-free (6 MV FFF) photon beams. Treatment was delivered on a Varian Ethos linear accelerator equipped with HyperSight CBCT.

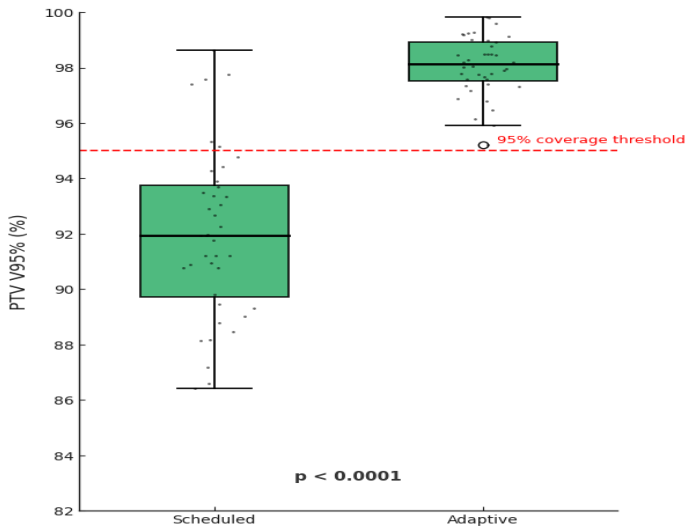


Figure 1. Comparison of PTV coverage (V95%) between scheduled and adaptive treatment plans. Box plots demonstrate a significant improvement in average PTV V95% with adaptive planning (98.1 ± 1.1%) compared to scheduled plans (92.7 ± 3.2%, p < 0.0001))

Results

ART was delivered using the Fast Forward regimen of 26 Gy in 5 fractions in 25 patients (62.5%), and 27 Gy in 5 fractions in 15 patients (37.5%). Most patients presented with early-stage, predominantly hormone receptor–positive subtypes (70%), and grade I–II tumors (82.5%). Thirteen patients (32.5%) had left-sided breast cancer. In all patients and across all fractions, the adapted plan was selected for treatment as it consistently provided superior dosimetric parameters. ART significantly improved target coverage, with mean PTV V95% increasing from 92.7 ± 3.2% in scheduled plans to 98.1 ± 1.1% in adaptive plans ($p < 0.0001$). Dose constraints for all organs at risk were met in both scheduled and adaptive plans. For the ipsilateral lung, the mean V30% was 14.5 ± 3.8% for scheduled and 15.7 ± 4.2% for adaptive plans, remaining below the protocol threshold of V30% ≤ 17%. For left-sided cases, heart V25% was 1.10 ± 2.04% in scheduled and 1.09 ± 1.59% in adaptive plans, while LAD Dmax averaged 1.74 ± 1.16 Gy (scheduled) and 1.89 ± 1.89 Gy (adaptive) Median follow-up was 7 months, during which two patients (5%) developed grade 1 erythema according to CTCAE v5.0, with no > grade 2 acute toxicity observed.

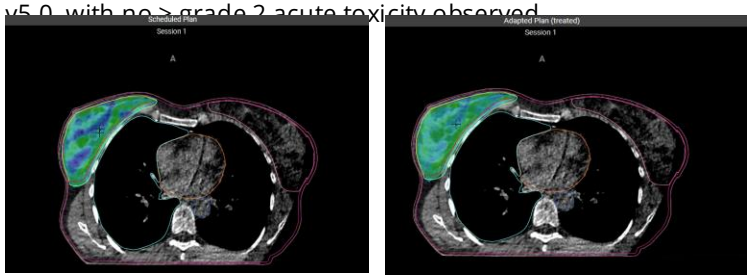


Figure 2. Comparison between scheduled and adaptive treatment plans.

Conclusion

CBCT-guided ART proved feasible, efficient, and clinically safe, achieving superior target coverage while maintaining excellent organ-at-risk sparing and minimal acute toxicity. These findings should be validated in a larger patient cohort.

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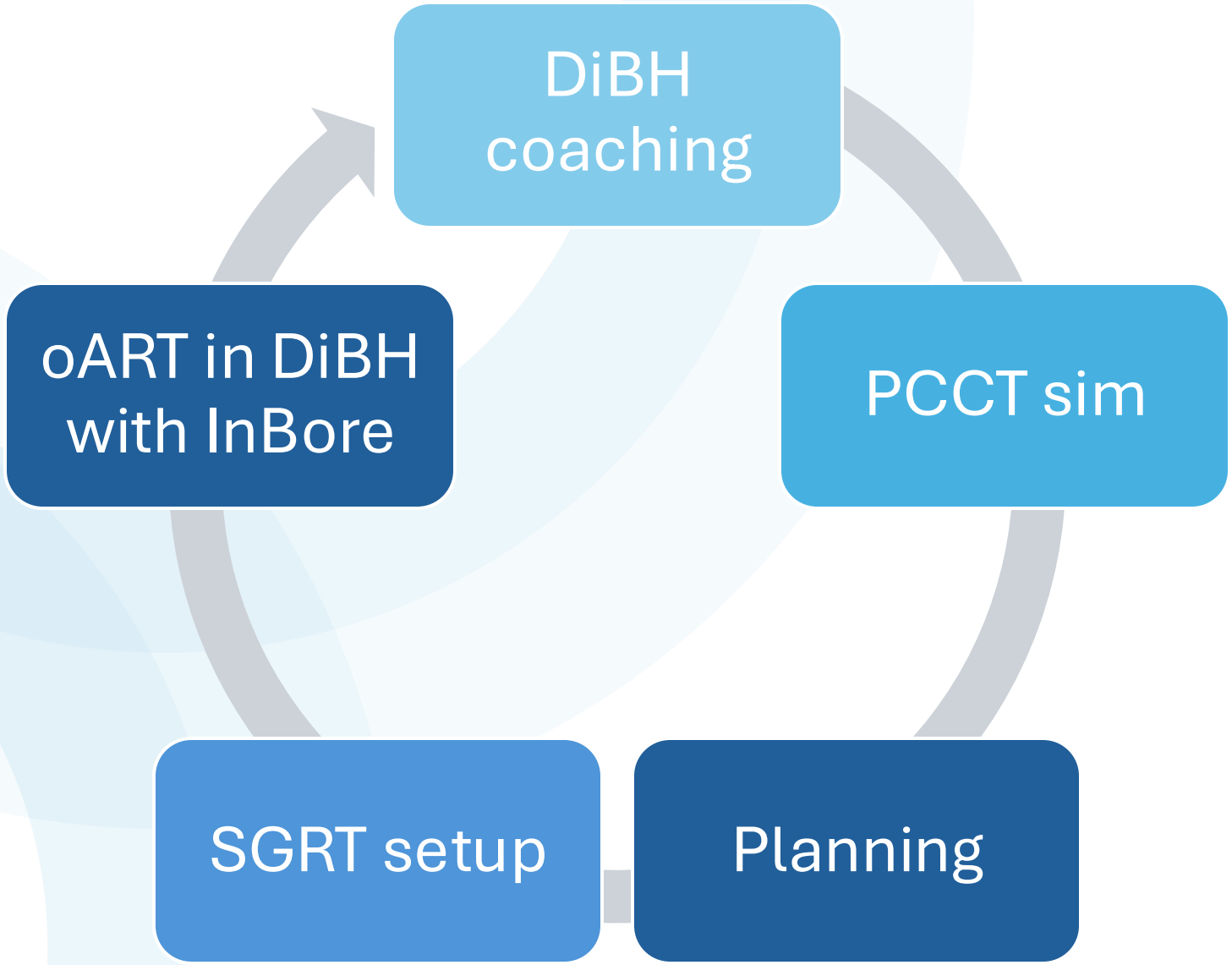
DiBH coaching
PCCT sim
Planning
SGRT setup
oART in DiBH with InBore

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PATIENT SETUP

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CONTROL CBCT

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TREATMENT

SGRT COMMUNITY

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Benefits of AlignRT InBORE

Patient coaching

Full visibility

More accurate and precise

Reduces treatmant time and repeated imaging

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THANK YOU FOR YOUR ATTENTION!

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Q&A

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