Breakout Session 1: Track A

Implementation of a Public Data Challenge for MRI-Guided Tumor Segmentation in Head and Neck Cancer Patients

Dr. Andrew Schaefer
Professor, Rice University

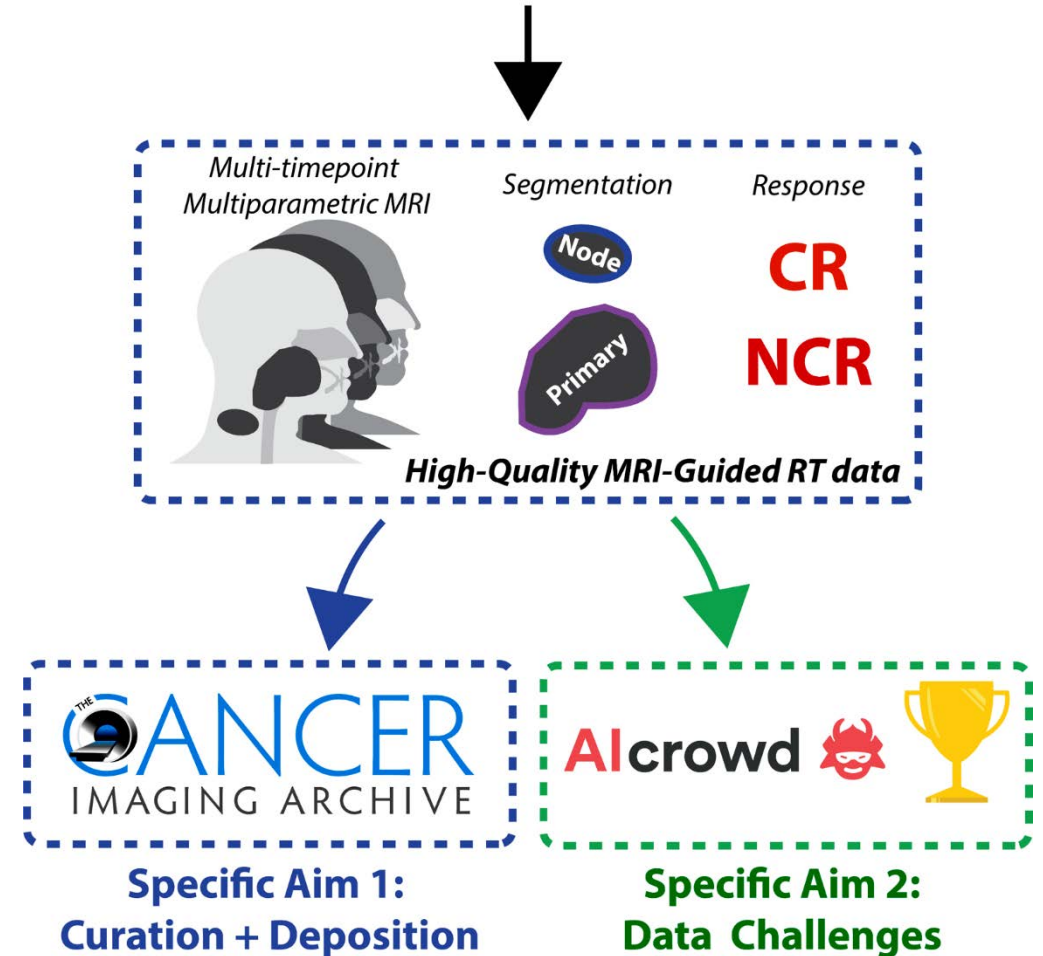# AI/ML Readiness for Head and Neck Cancer MRI Data

Andrew Schaefer

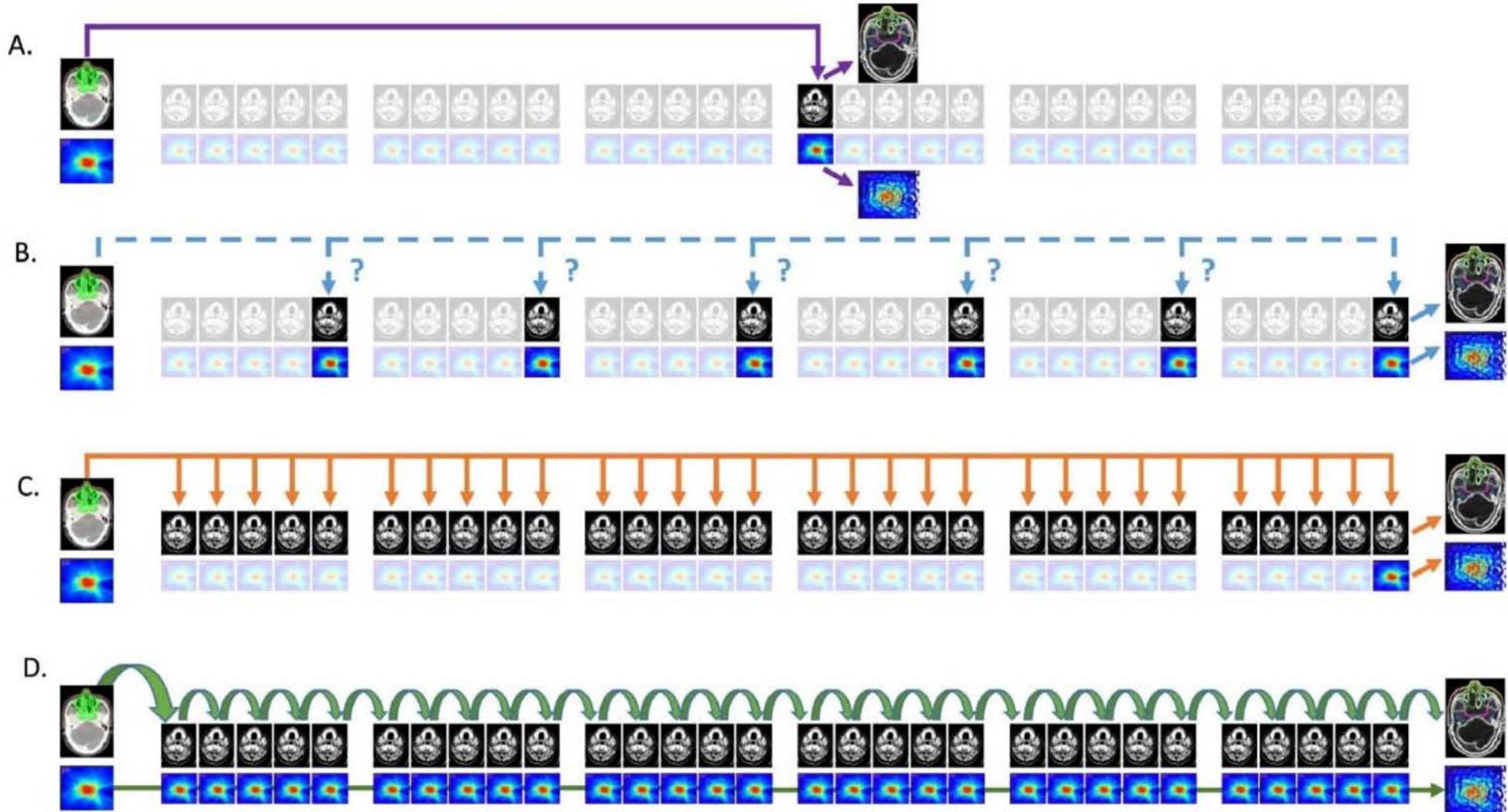March 27, 2024

AI/ML Readiness Supplements

- *3R01CA257814-03S2*;
SCH: Personalized Rescheduling of Adaptive Radiation Therapy for Head & Neck Cancer

"There is an *unmet need to systematically curate, pre-process, and disseminate multi-timepoint multi-parametric HNC MRI data* and corresponding *multi-observer annotations for public use* in AI models for adaptive RT applications. The following specific aims will act as a supplement to the existing parent grant to **provide the research community with high-quality and re-usable RT benchmark dataset of established provenance**."
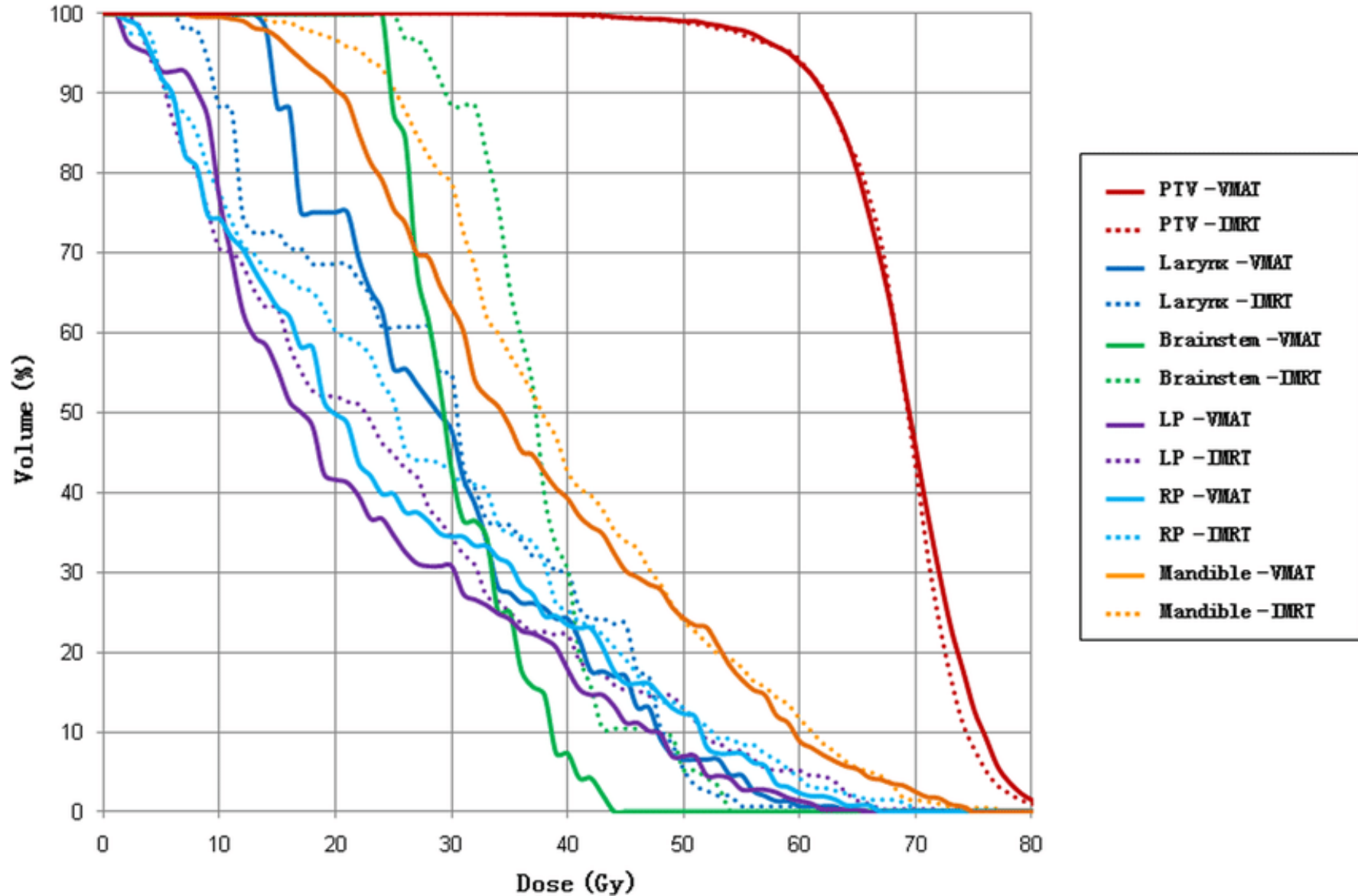

MD Anderson Cancer Center

Multi-timepoint Multiparametric MRI — Segmentation — Response

Node

Primary

CR
NCR

High-Quality MRI-Guided RT data

THE CANCER IMAGING ARCHIVE

AIcrowd

Specific Aim 1:
Curation + Deposition

Specific Aim 2:
Data Challenges
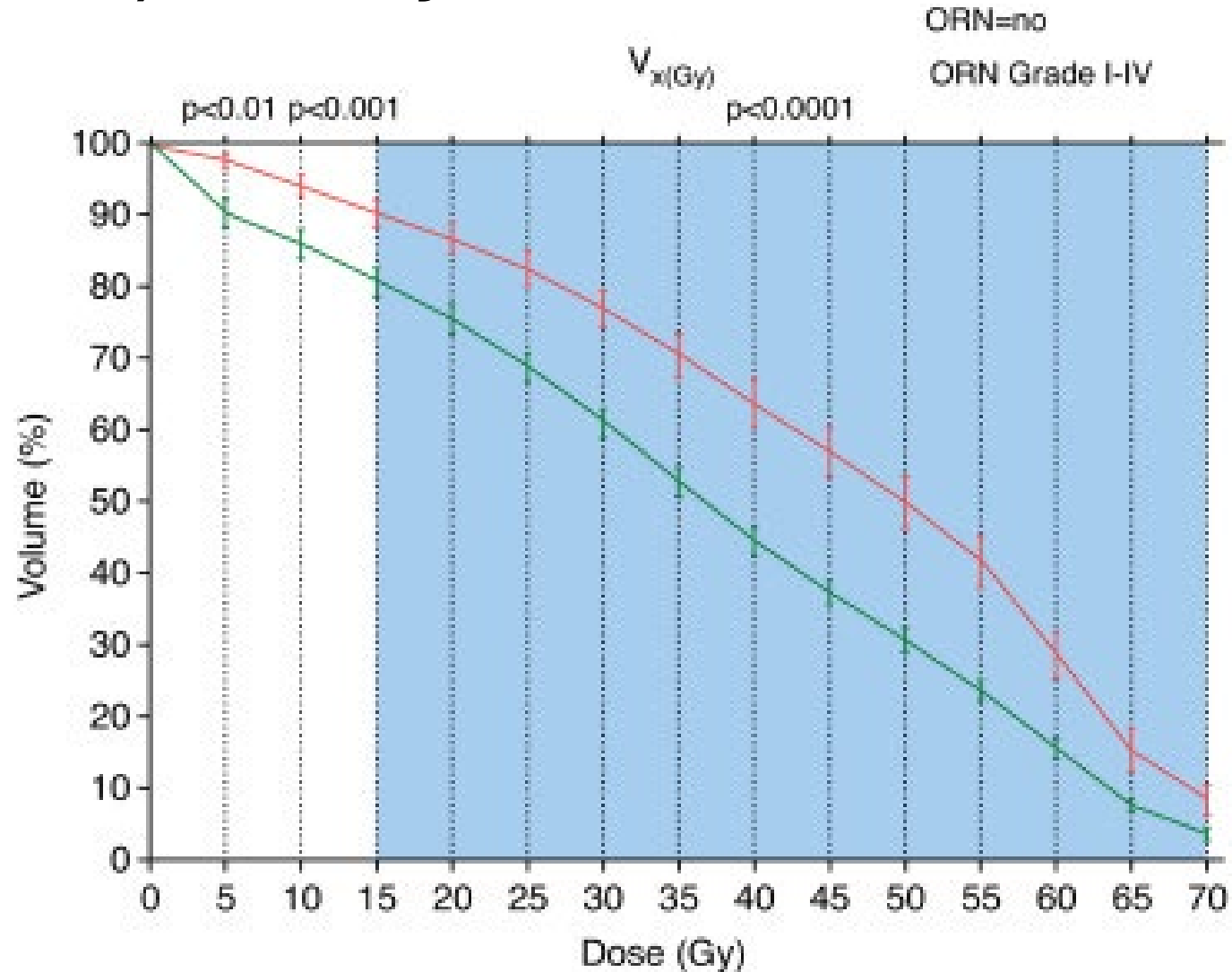
Adaptive RT==new daily dose
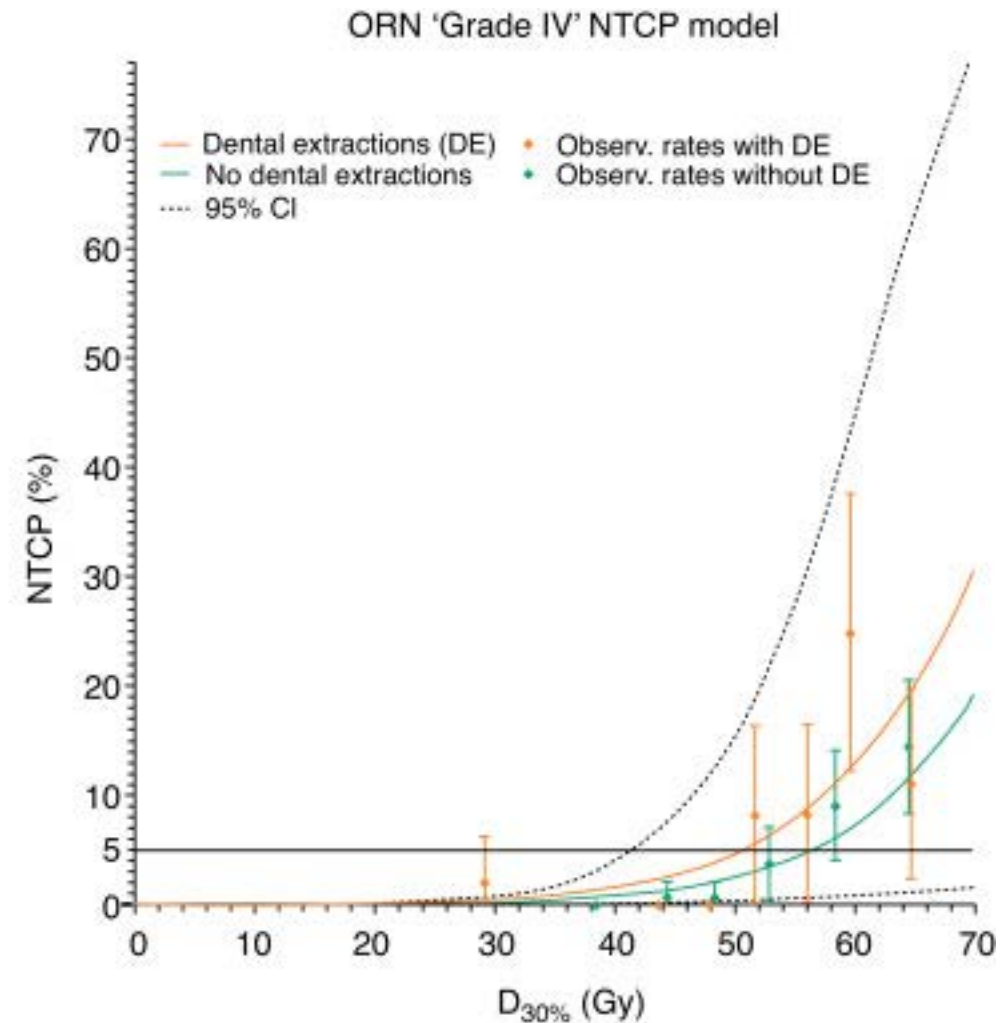
Dose-volume histogram

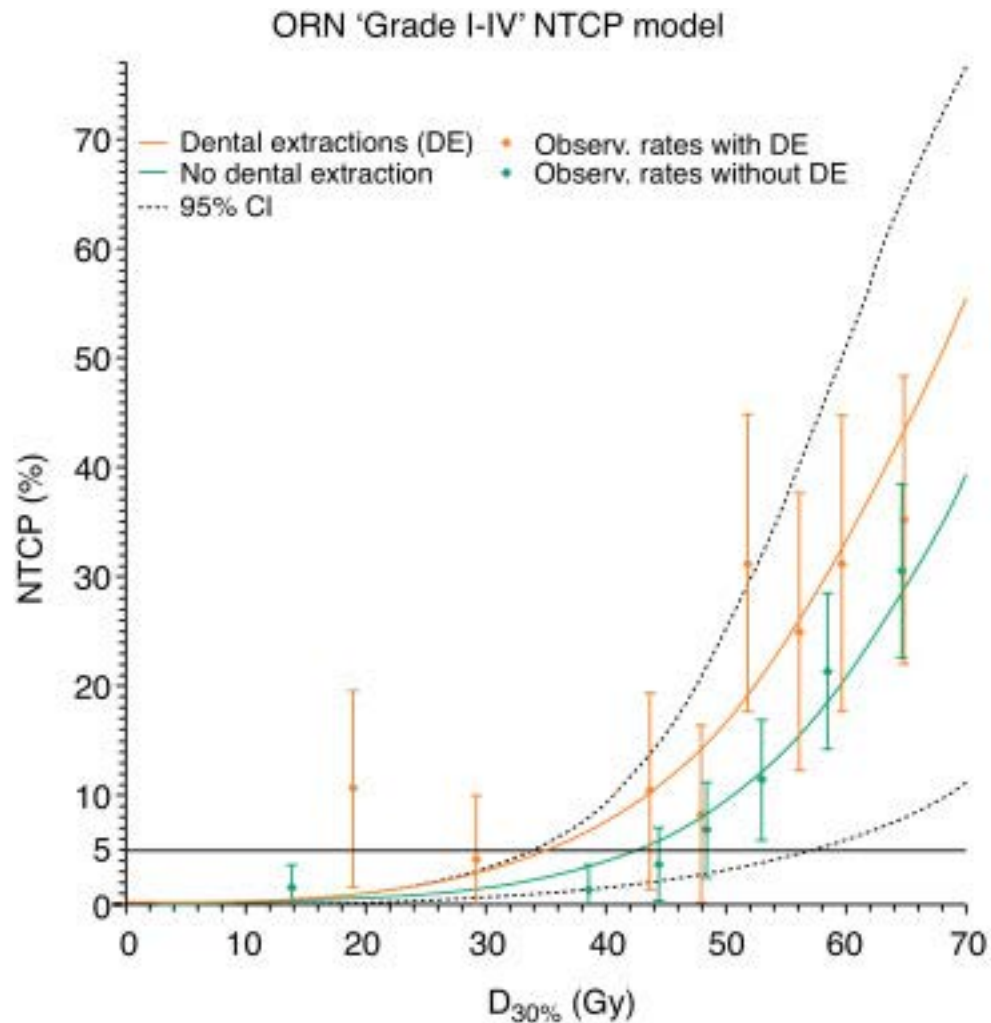# Dose-volume histogram for organ at risk (OAR) (mandible) toxicity

Normal tissue complication probability (NTCP)

ORN 'Grade I-IV' NTCP model

Legend:
- Dental extractions (DE)
- No dental extraction
- 95% CI
- Observ. rates with DE
- Observ. rates without DE

Axes: NTCP (%) vs $D_{30\%}$ (Gy)

ORN 'Grade IV' NTCP model

Legend:
- Dental extractions (DE)
- No dental extractions
- 95% CI
- Observ. rates with DE
- Observ. rates without DE

Axes: NTCP (%) vs $D_{30\%}$ (Gy)

Hybrid 1.5T
MRI-**Li**near **Ac**celerator (MR-LinAc)
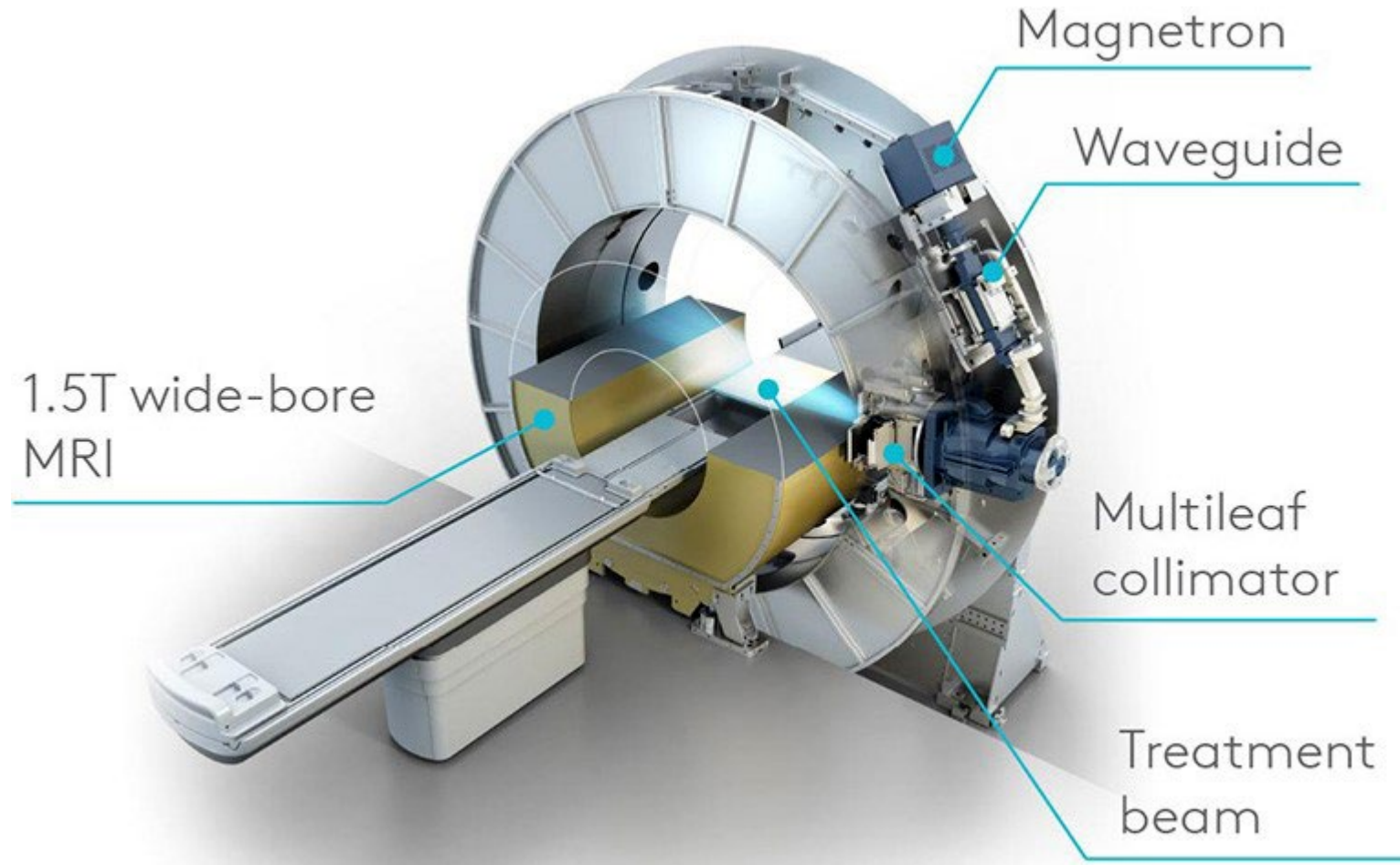
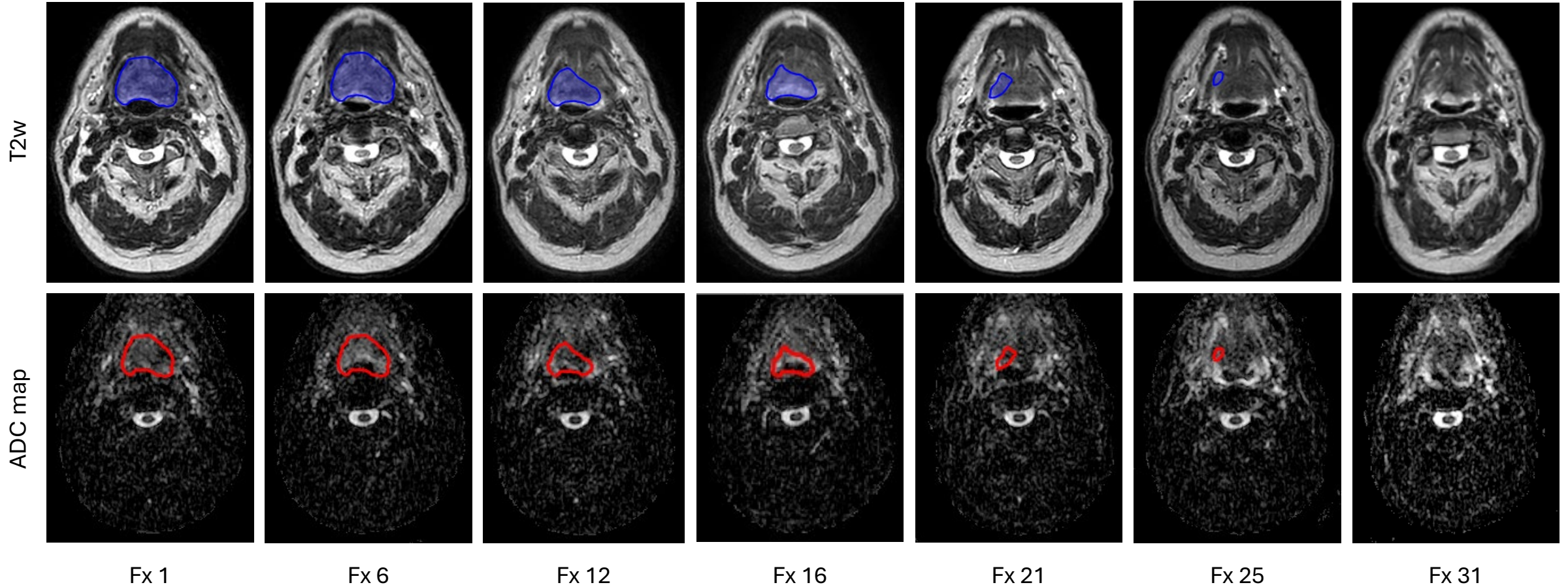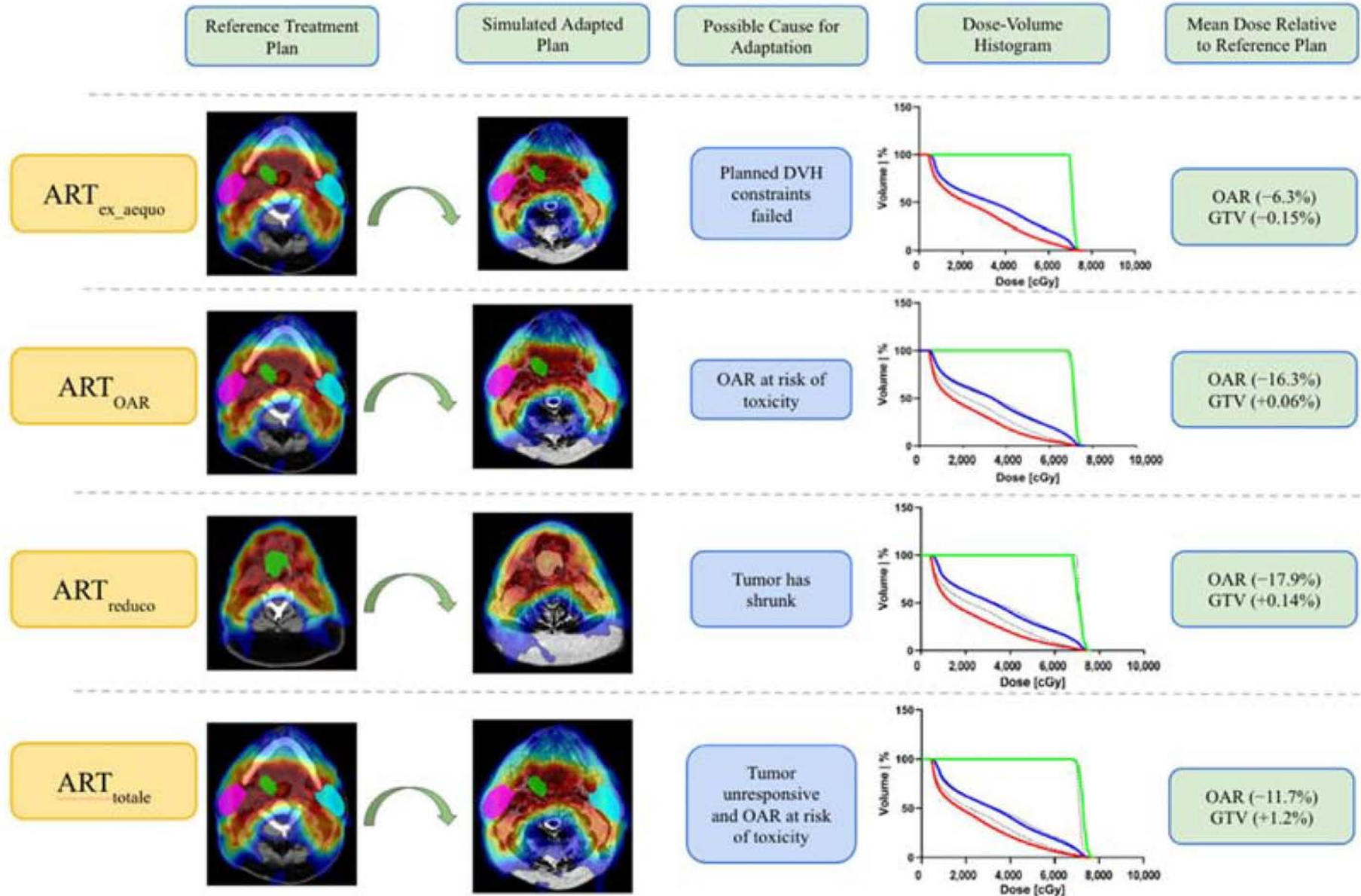So, now we can see tumor before, during, and after treatment, both anatomically and functionally.

Adaptive NTCP analysis

The first SA of the parent grant (1R01CA257814-0) proposes mid-therapy re-optimization of the treatment plan based on the tumor response and predicted trajectory of the normal tissue injury. This requires frequent segmentation of the tumor by the physicians at a higher frequency as well as higher computational resources,
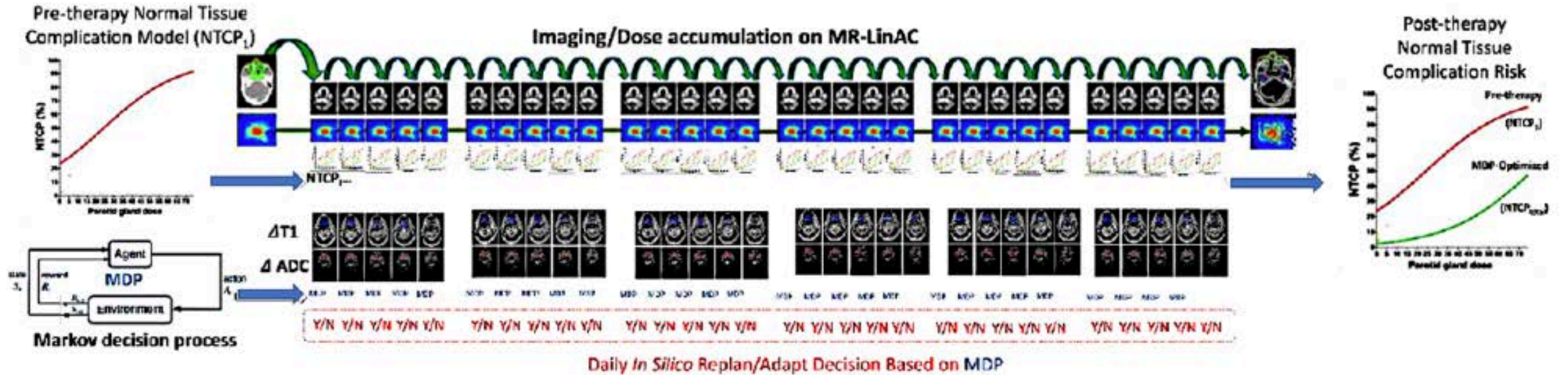
Figure 1: Graphical of the parent award, showing serial daily imaging and NTCP-based ART modeling.

Included datasets

Retrospective Research study protocol (RCR 03-0800)
- MDA Oropharynx Cancer treated patients with image study was included
    - Total Number of patients:
      N =36 Multi-timepoint MRI (including T1, T2, DWI) image study
      69 MRI (including T1, T2, DWI) image study

* Pre-therapy — Mid-therapy — Post-therapy Image Studies/each Patient

Osteoradionecrosis in Head & Neck Cancer clinical trial (PA16-0302)
- PRE-, MID- and POST- Treatment MRI (including T1, T2, DWI) image study/each
- CT (sim/dose) image study
    - Total Number of patients:
      N =160

* 30-33 Fractions of Daily MRI Images/each Patient

The MOMENTUM observational clinical trial (PA18-0341)
The MR-ADAPTOR phase II clinical trial (NCT03224000)
- 30-33 Fractions of Daily MRI (including T1, T2, DWI) image study/each
- CT (sim/dose) image study
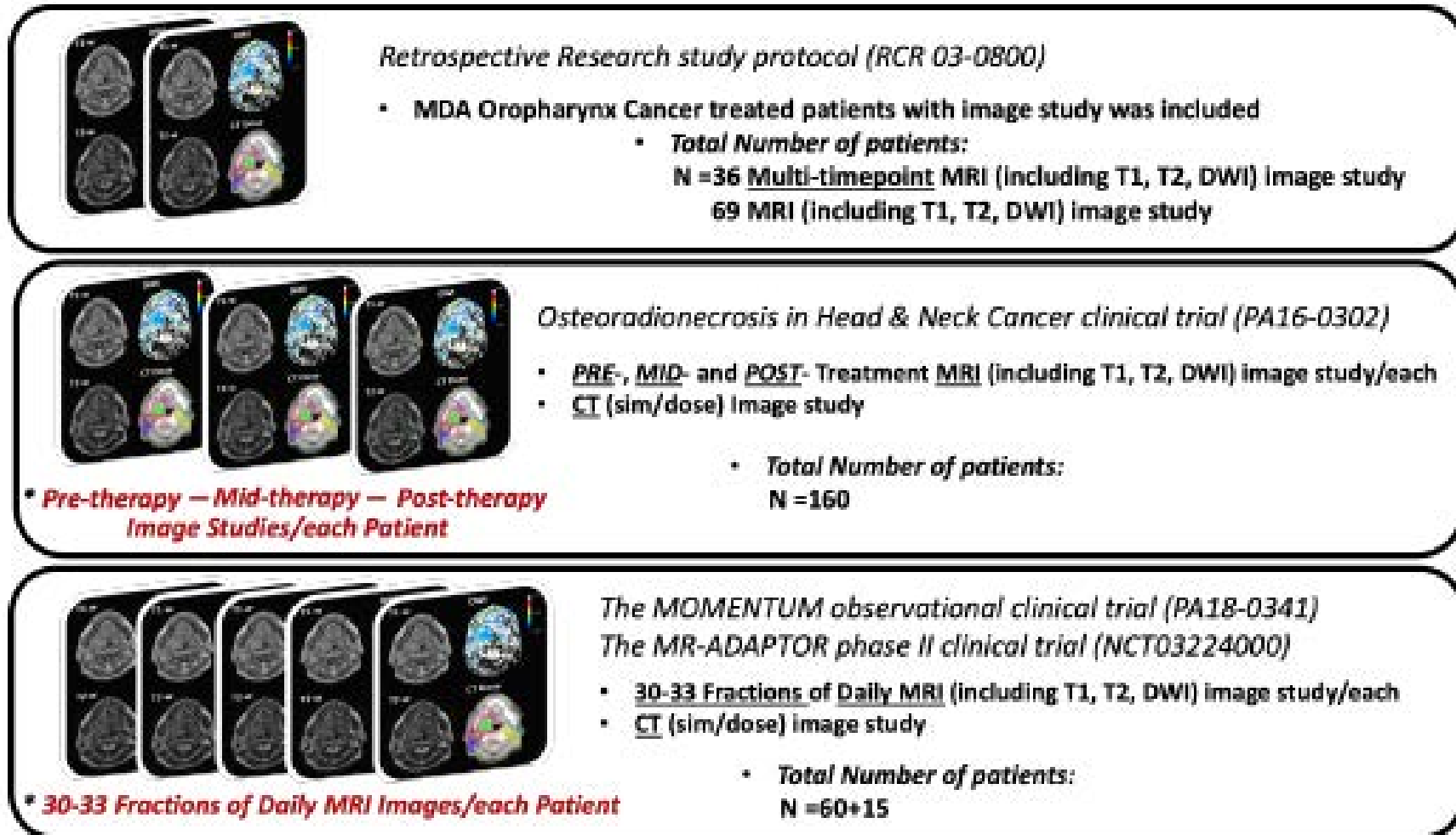   - Total Number of patients:
      N =60+15

Figure 2a: Primary data sources to be support the specific aims of the proposed efforts
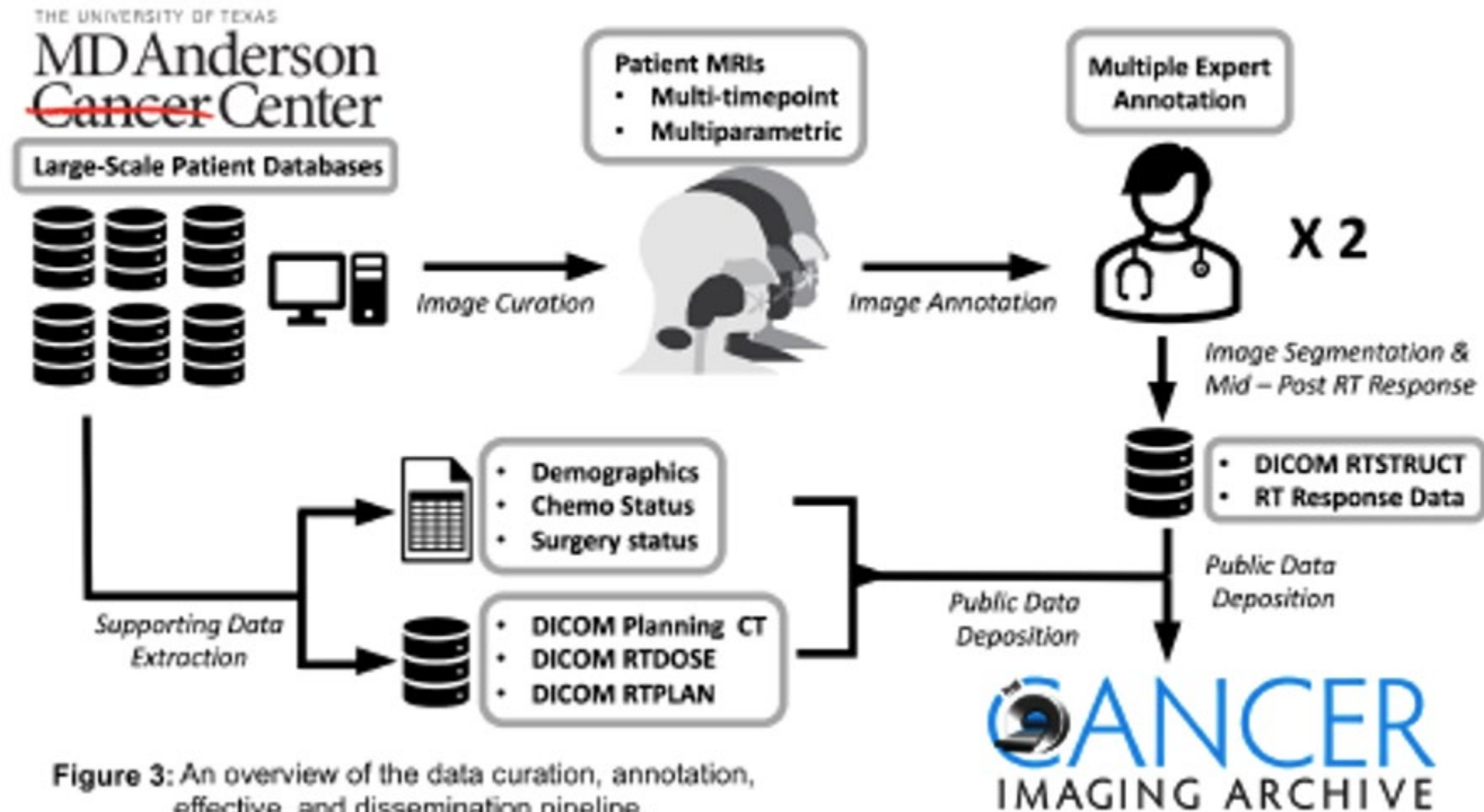
SA 1: Data Curation

Figure 3: An overview of the data curation, annotation, effective, and dissemination pipeline.

SA1 Important Milestones

- Dataset proposal has been officially accepted by The Cancer Imaging Archive (**TCIA**).

- Biweekly ongoing discussions with TCIA administrators are setting the stage for our eventual data submission.

Need for MR-guided data challenges in HNC

- MRI-guided approaches becoming increasingly crucial for HNC RT treatment planning.
  - Allow for increased soft tissue contrast/resolution and functional imaging.

- To-date, no large publicly available AI-ready MR-guided datasets for public algorithmic development.

MR-Linac = real-time imaging + treatment

Source: Elekta

Current Challenge Timeline

- Registration period: May 1 - June 15
- Release date of training cases: June 15
- Release date of test cases: August 15
- Participant submission dates: August 15 - September 15
- Paper abstract submission deadline: September 15
- Release date of results: September 20
- Full paper submission deadline: September 20.
- Live event: After October 10th (MICCAI)
- Deadline for final papers: November 1st.