

Breakout Session 4: Track B

Leveraging MRI applications for FAIR and Open (Re)Use

Dr. Clifton Fuller (Moderator)
Professor, UT MD Anderson Cancer Center



MR for Head and Neck Cancer

AI/ML-Readiness of NIH-Supported Data for Parent Award Development of functional magnetic resonance imaging-guided adaptive radiotherapy for head and neck cancer patients using novel MR-Linac device

(R01DE028290-04S2)

PI: Clifton (Dave) Fuller

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- NIH-NCI Postdoctoral Training Program (T32CA261856)
- NIH- NIDCR Prospective Observational or Biomarker Validation Study Cooperative Agreement (U01DE032168)
- NIH-NCI Joint NSF/NIH Smart Connected Health Program Award (R01CA257814)
- NIH- NCI/BD2K Early-Stage Technologies in Biomedical Computing, Informatics, and Big Data Science Award (R01CA214825)
- NIH- NCI Joint NSF/NIH Quantitative Approaches to Biomedical Big Data (R01CA225190)
- NIH-NCI Early Phase Clinical Trials in Imaging and Image-Guided Interventions (R01CA218148)
- NIH- NIDCR Academic-Industrial Partnerships to Translate and Validate in vivo Cancer Imaging Systems Award (R01DE028290)
- NIH- NIBIB Research Education Programs for Residents and Clinical Fellows Award (R25EB025787)
- NIH NCI Parent Research Project Grant (R01CA258827)
- NIH NCI Early Phase Clinical Trials in Imaging and Image-Guided Interventions Program (1R01CA218148)
- NIH-NCI Cancer Center Support Grant (CCSG) (P30CA016672)
- NIH NCI Small Business Innovation Research Grant Program sub-award (R43CA254559)
- NIH HuBMAP Integration, Visualization & Engagement (HIVE) Initiative (OT2OD026675) sub-award
- NIH NIDCR Exploratory/Developmental Research Grant Program (R21DE031082)
- Patient-Centered Outcomes Research Institute (PCS-1609-36195) sub-award from Princess Margaret Hospital
- National Science Foundation (NSF) Division of Civil, Mechanical, and Manufacturing Innovation (CMMI) Award (1933369)
- Elekta AB/MD Anderson MRI-LinAc Consortium Seed Grant*
- Elekta AB Travel support & Honoraria*
- Honoraria/in-kind registration reimbursement from professional societies: ASCO, AAPM, ESTRO, ASTRO, RANZCR
- Charles & Daneen Steifel Oropharynx Research Fund

Federal funder

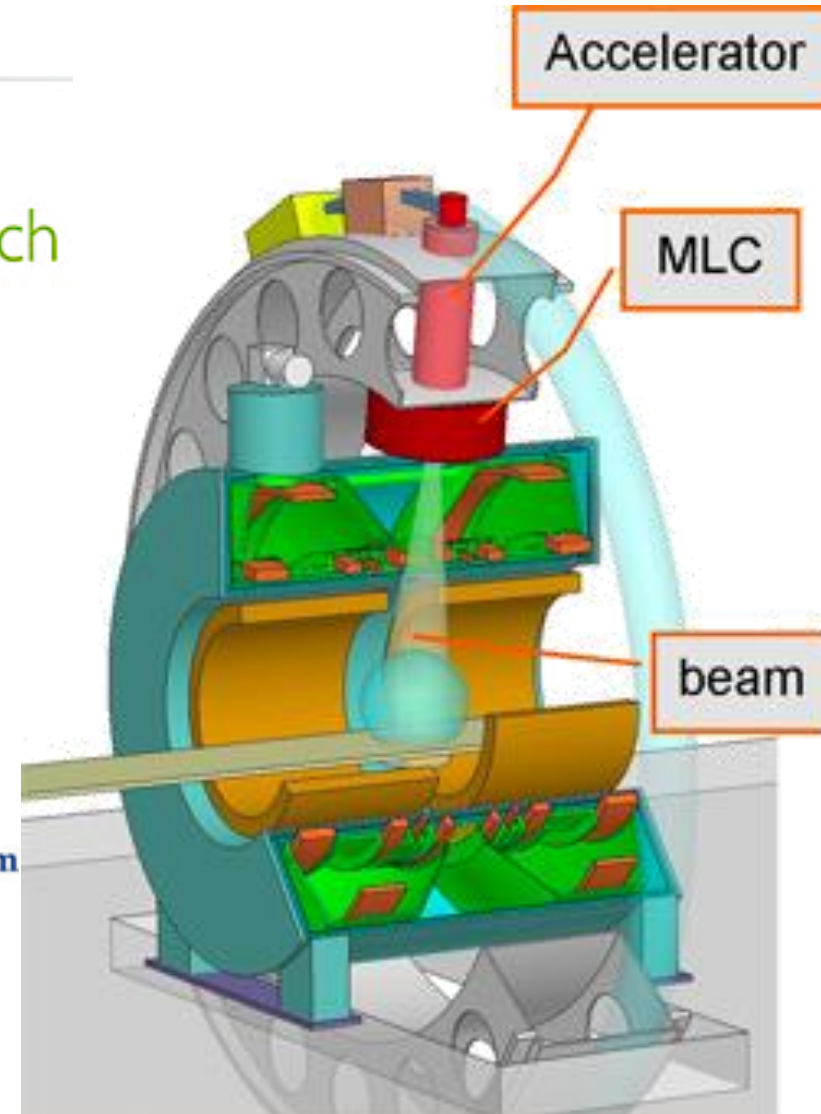
Industry/For-Profit

Philanthropic



MR-LinAc: 2011

Elekta and Philips Gain MD Anderson Cancer Center as Collaborator in Research Consortium on MRI-Guided Radiation Therapy



Universitair Medisch Centrum
Utrecht

PHILIPS



ELEKTA

The Parent Project



Academic

- Clinical experience
- Clinical trial data
- Hypothesis-driven research approach

Industrial

- Technical expertise
- Project and technical support
- Product development approach

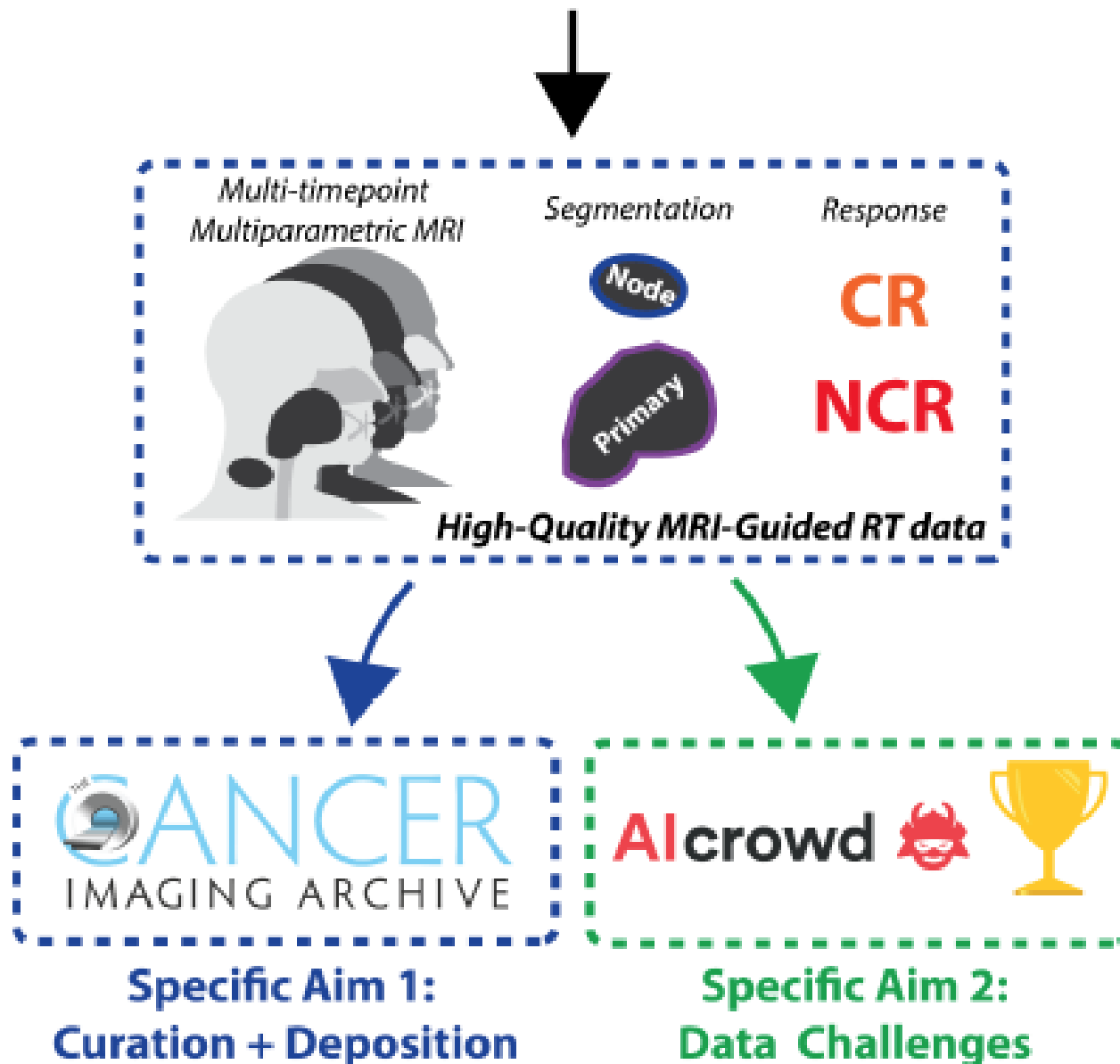
Partnership

Funding source:



National Institute of Dental and Craniofacial Research

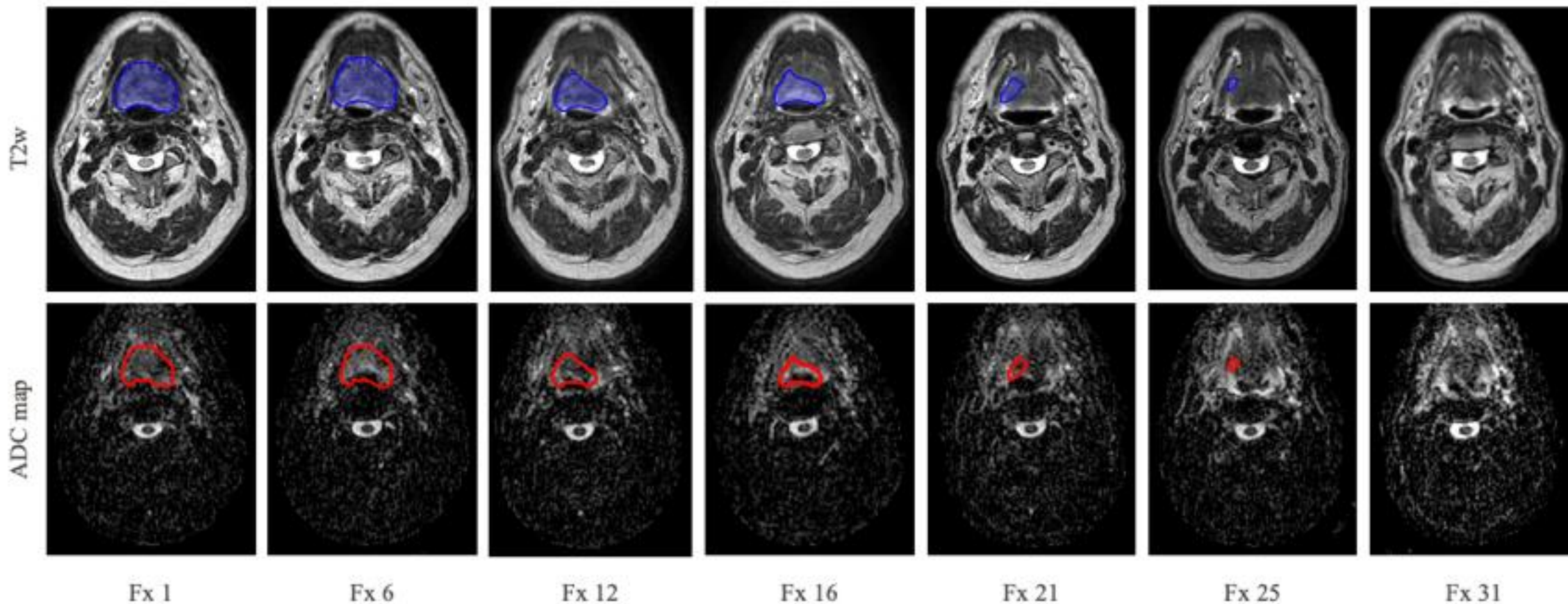
- Ability to work towards a unified vision
- Weekly team calls and frequent communication



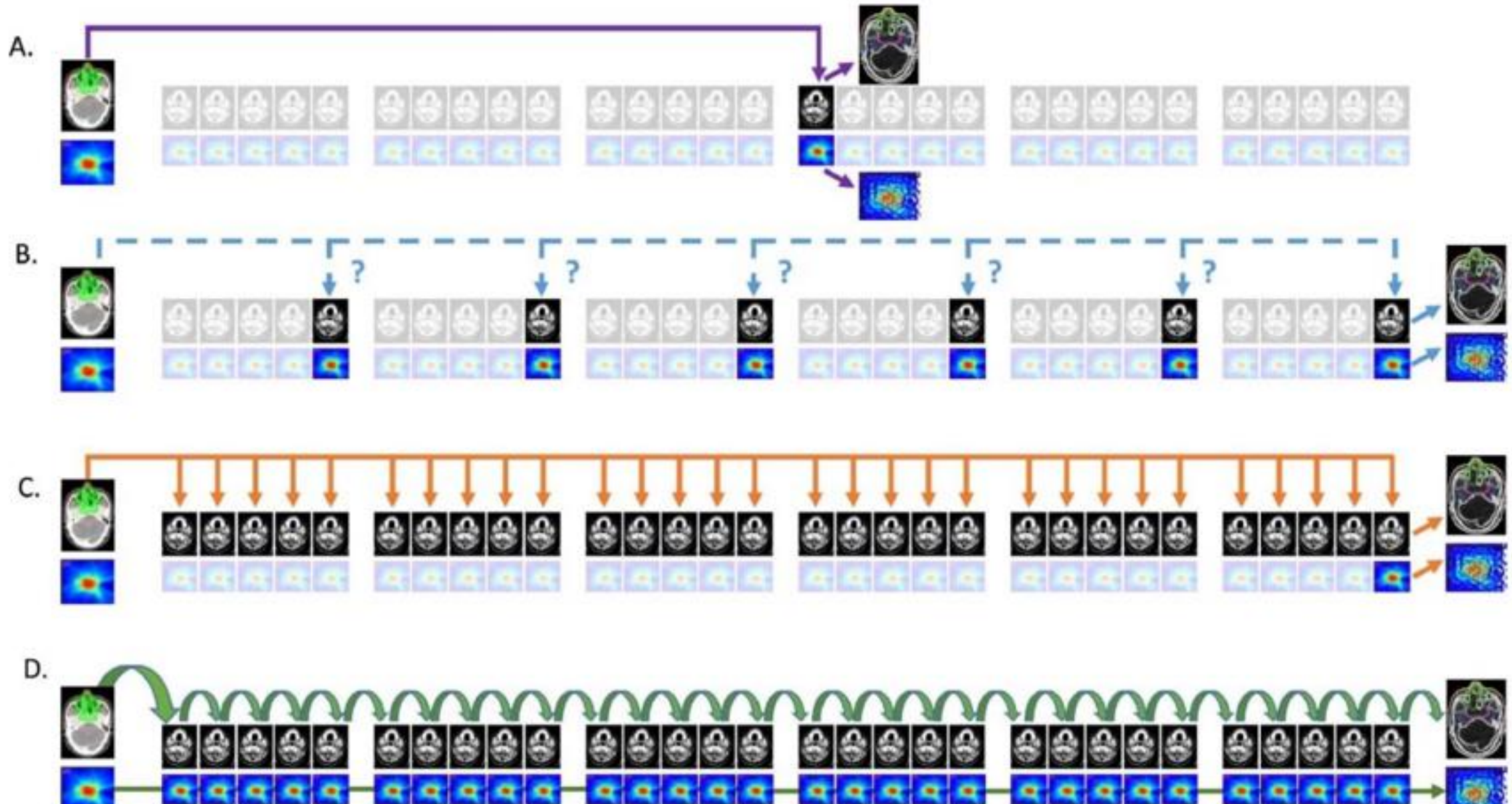
Graphical Abstract. High-quality image and annotation data will be curated and publicly disseminated (*Specific Aim 1*) and used for public data challenges (*Specific Aim 2*).



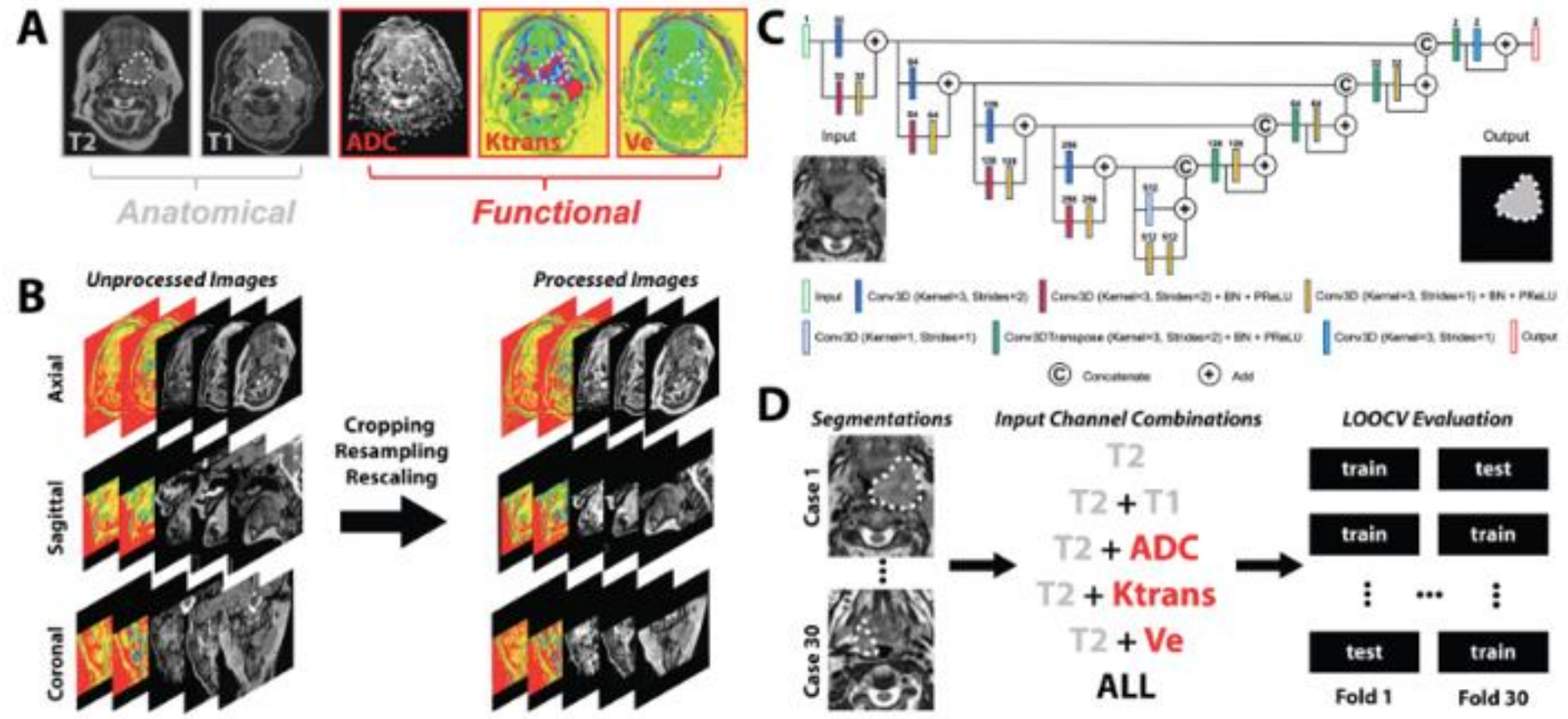
Multi-parametric MRI daily



Problem: Segmentation variability over many daily fractions



Evaluation of deep learning-based multiparametric MRI oropharyngeal primary tumor auto-segmentation and investigation of input channel effects: Results from a prospective imaging registry



Kareem A. Wahid^a, Sara Ahmed^a, Renjie He^a, Lisanne V. van Dijk^a, Jonas Teuwen^b, Brigid A. McDonald^a, Vivian Salama^a, Abdallah S.R. Mohamed^a, Travis Salzillo^a, Cem Dede^a, Nicolette Taku^a, Stephen Y. Lai^c, Clifton D. Fuller^{a,*}, Mohamed A. Naser^{a,*}

T2

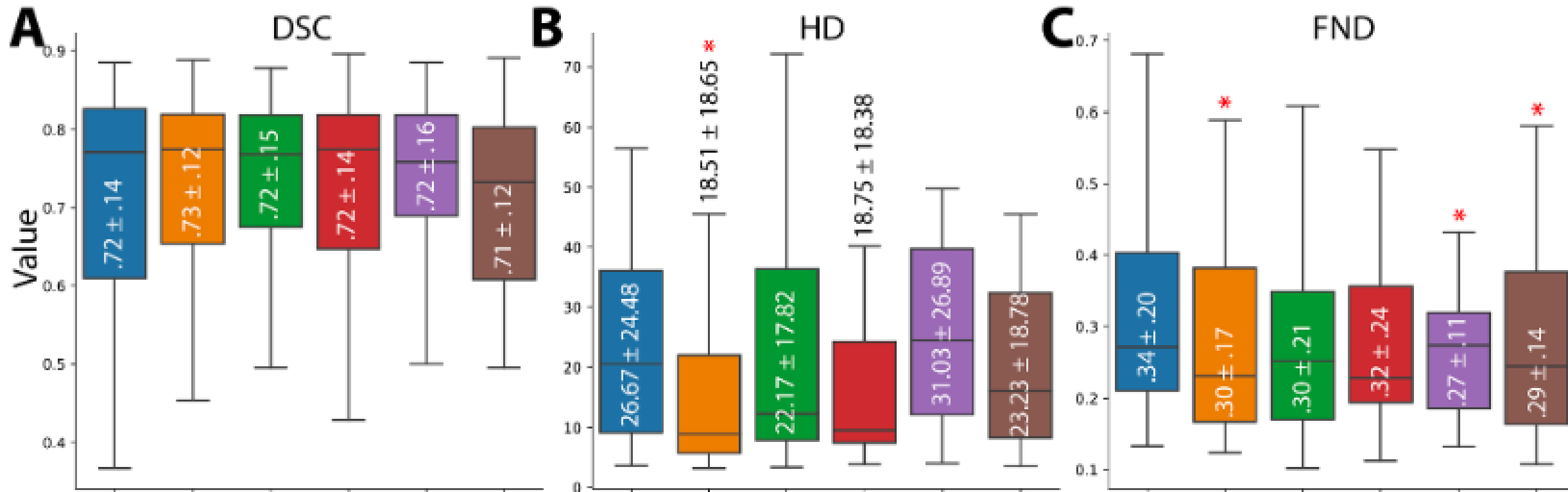
T2+T1

T2+ADC

T2+Ktrans

T2+Ve

All



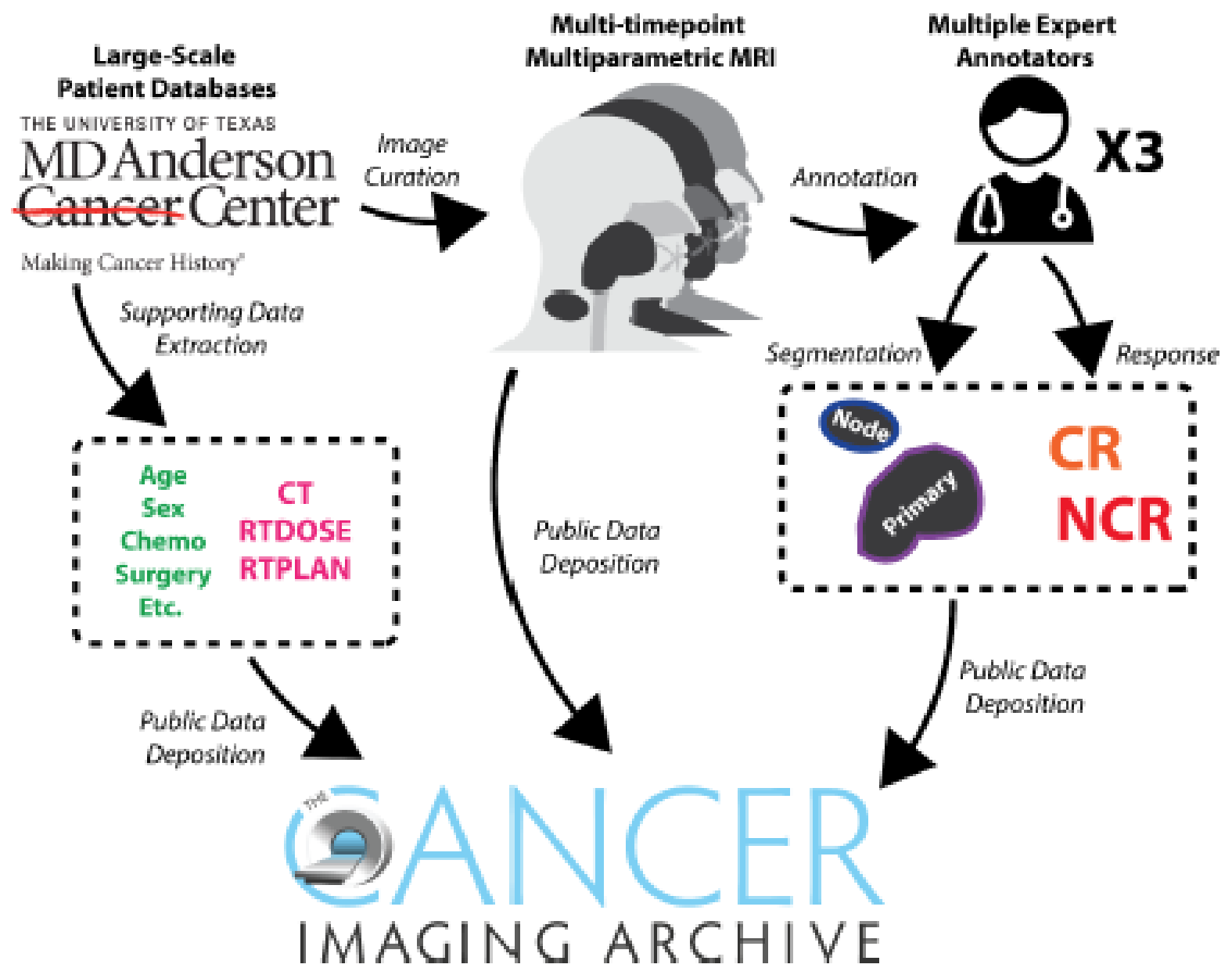
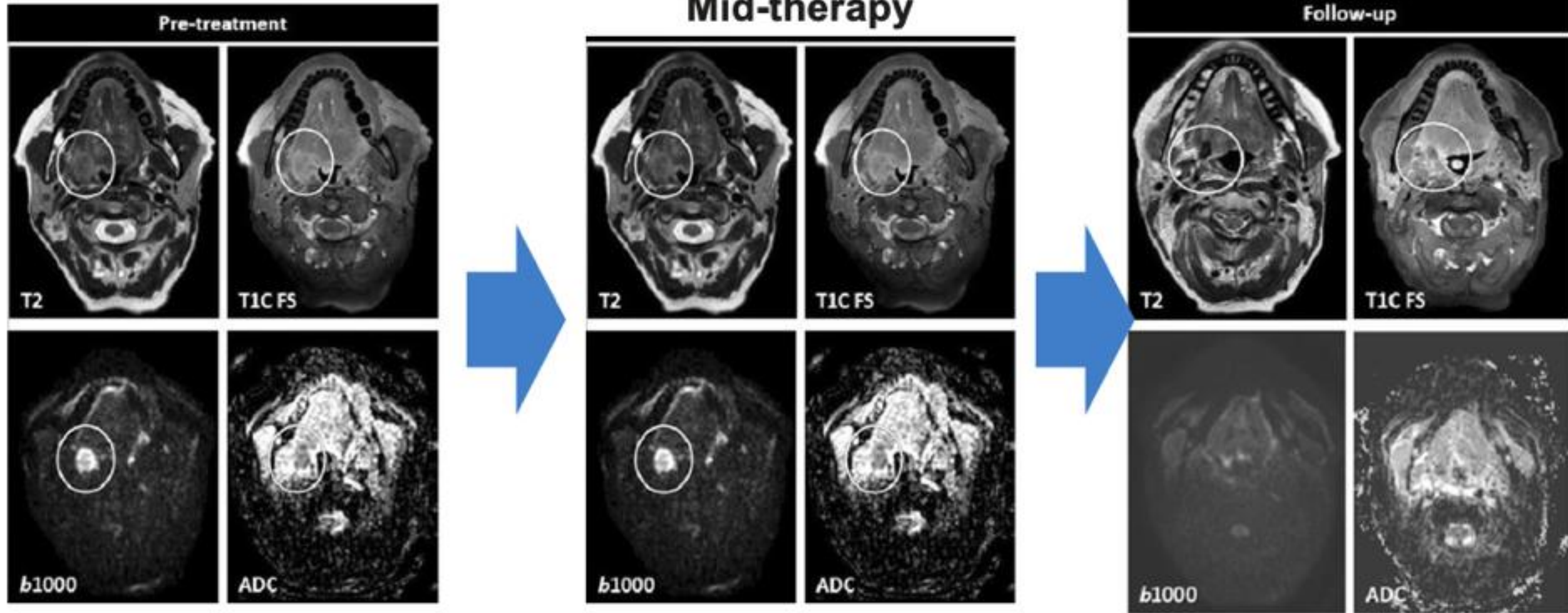


Figure 5. Workflow for Specific Aim 1. We will curate high-quality images, annotations, and supporting data, and subsequently deposit them to public repositories.

Segment pre- and post-RT images compared to Challenge 2: Predict post-RT response



Milestones

- Approved for deposition in the The Cancer Imaging Archive
- Manual segmentation by multiple observers (n=3) completed, undergoing QA
- Accepted for MICCAI 2024 Challenges
- Dataset release after MICCAI Challenges

Challenges to the challenges

- Infrastructure for data curation was delayed by administrative barriers
- Manual segmentation more challenging than anticipated
- Data drift in MRI sequences used created standardization challenge



Peer-Reviewed Publications

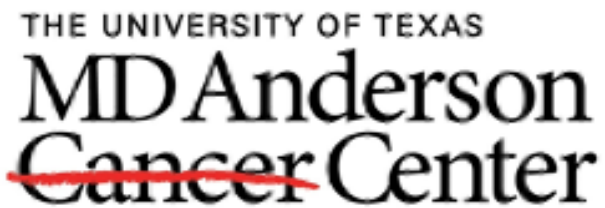
- Wahid KA, Glerean E, Sahlsten J, Jaskari J, Kaski K, Naser MA, He R, Mohamed ASR, Fuller CD. Artificial Intelligence for Radiation Oncology Applications Using Public Datasets. *Semin Radiat Oncol.* 2022 Oct;32(4):400-414. doi: 10.1016/j.semradonc.2022.06.009. PMID: 36202442; PMCID: PMC9587532.
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- El-Habashy DM, Wahid KA, Renjie H, McDonald B, Mulder SJ, Ding Y, Salzillo T, Stephen L, Christodouleas J, Dresner A, Wang J, Naser MA, Fuller CD, Mohamed ASR. Weekly Intra-Treatment Diffusion Weighted Imaging Dataset for Head and Neck Cancer Patients Undergoing MR-linac Treatment. *medRxiv [Preprint]*. 2023 Aug 20:2023.08.18.23294280. doi: 10.1101/2023.08.18.23294280. PMID: 37645931; PMCID: PMC10462225.
- Sahlsten J, Wahid KA, Glerean E, Jaskari J, Naser MA, He R, Kann BH, Mäkitie A, Fuller CD, Kaski K. Segmentation stability of human head and neck cancer medical images for radiotherapy applications under de-identification conditions: Benchmarking data sharing and artificial intelligence use-cases. *Front Oncol.* 2023 Feb 28;13:1120392. doi: 10.3389/fonc.2023.1120392. PMID: 36925936; PMCID: PMC10011442.
- Naser MA, Wahid KA, Ahmed S, Salama V, Dede C, Edwards BW, Lin R, McDonald B, Salzillo TC, He R, Ding Y, Abdelaal MA, Thill D, O'Connell N, Willcut V, Christodouleas JP, Lai SY, Fuller CD, Mohamed ASR. Quality assurance assessment of intra-acquisition diffusion-weighted and T2-weighted magnetic resonance imaging registration and contour propagation for head and neck cancer radiotherapy. *Med Phys.* 2023 Apr;50(4):2089-2099. doi: 10.1002/mp.16128. Epub 2022 Dec 29. PMID: 36519973; PMCID: PMC10121748.

Presentations and Educational Materials

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- Fuller, Clifton (2023). Visting Professor, Odense University, 2023: "From Anatomic- to Biomarker-guided Rt: Challenges and Opportunities".. figshare. . <https://doi.org/10.6084/m9.figshare.24448657.v1>
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The Team



- PI: Dave Fuller
- Kareem Wahid
- Cem Dede
- Lucas McCullum
- Brigid McDonald
- Mohamed Naser
- Abdallah Mohamed
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- Renjie He
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- Jiaofeng Xu
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- Chunhua Men
- Etienne Lessard

- PI: Alex Dresner