Breakout Session 4: Track B

Leveraging MRI applications for FAIR and Open (Re)Use

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MR-linac CONSORTIUM

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**)

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MD Anderson

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- 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)
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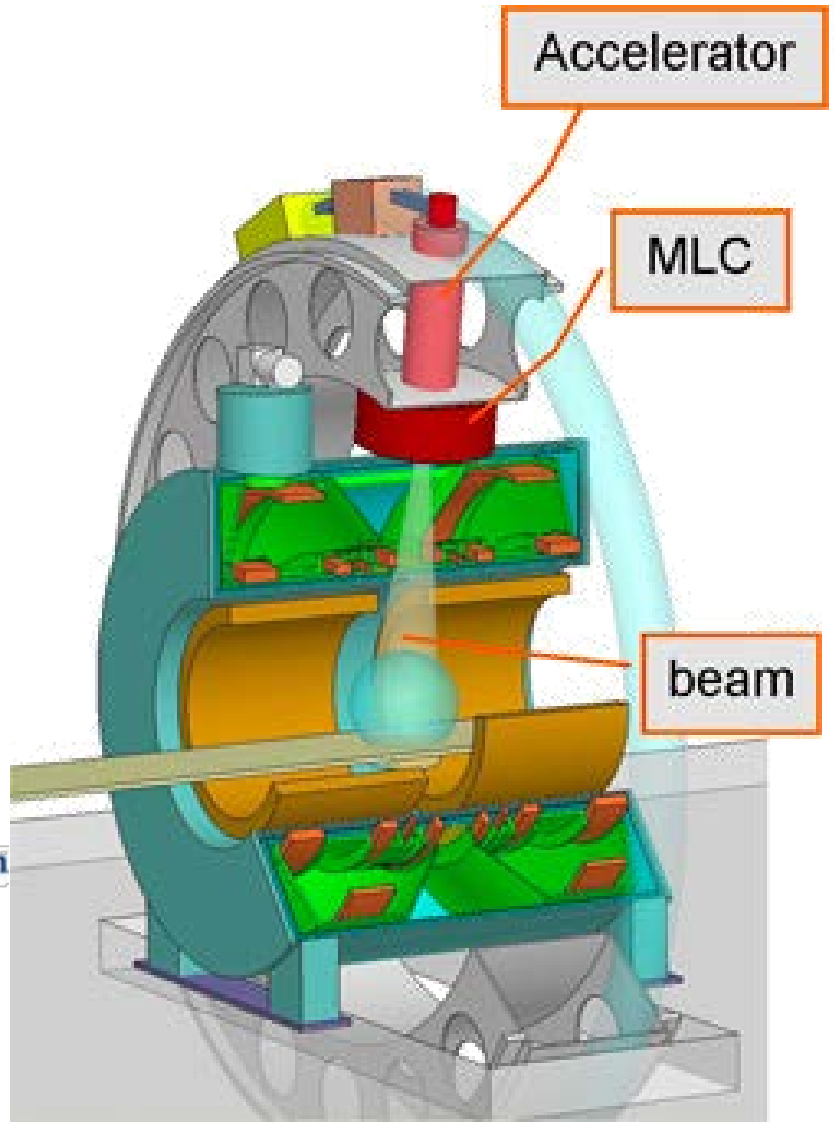
- Charles & Daneen Steifel Oropharynx Research Fund

MR-LinAc: 2011

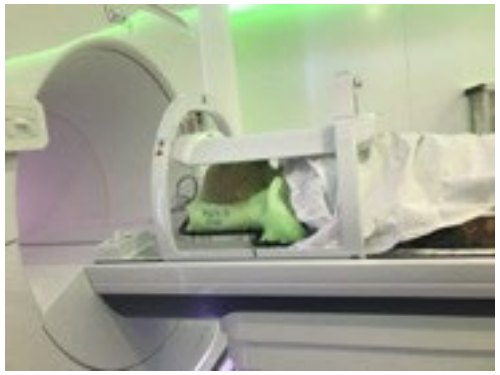
Elekta and Philips Gain MD Anderson Cancer Center as Collaborator in Research Consortium on MRI-Guided Radiation Therapy

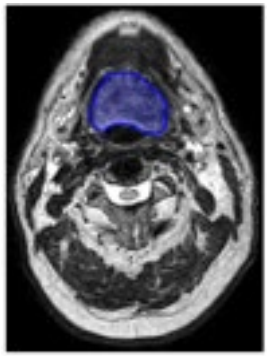


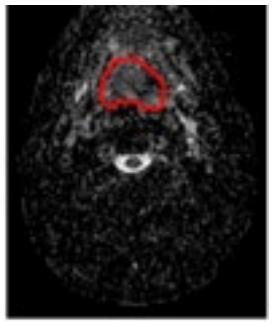
The Parent Project

FREEDOM-RT: Functional Imaging for Real-time Early Evaluation of Dose-response with On-line Multiparametric MRI-guided RadioTherapy

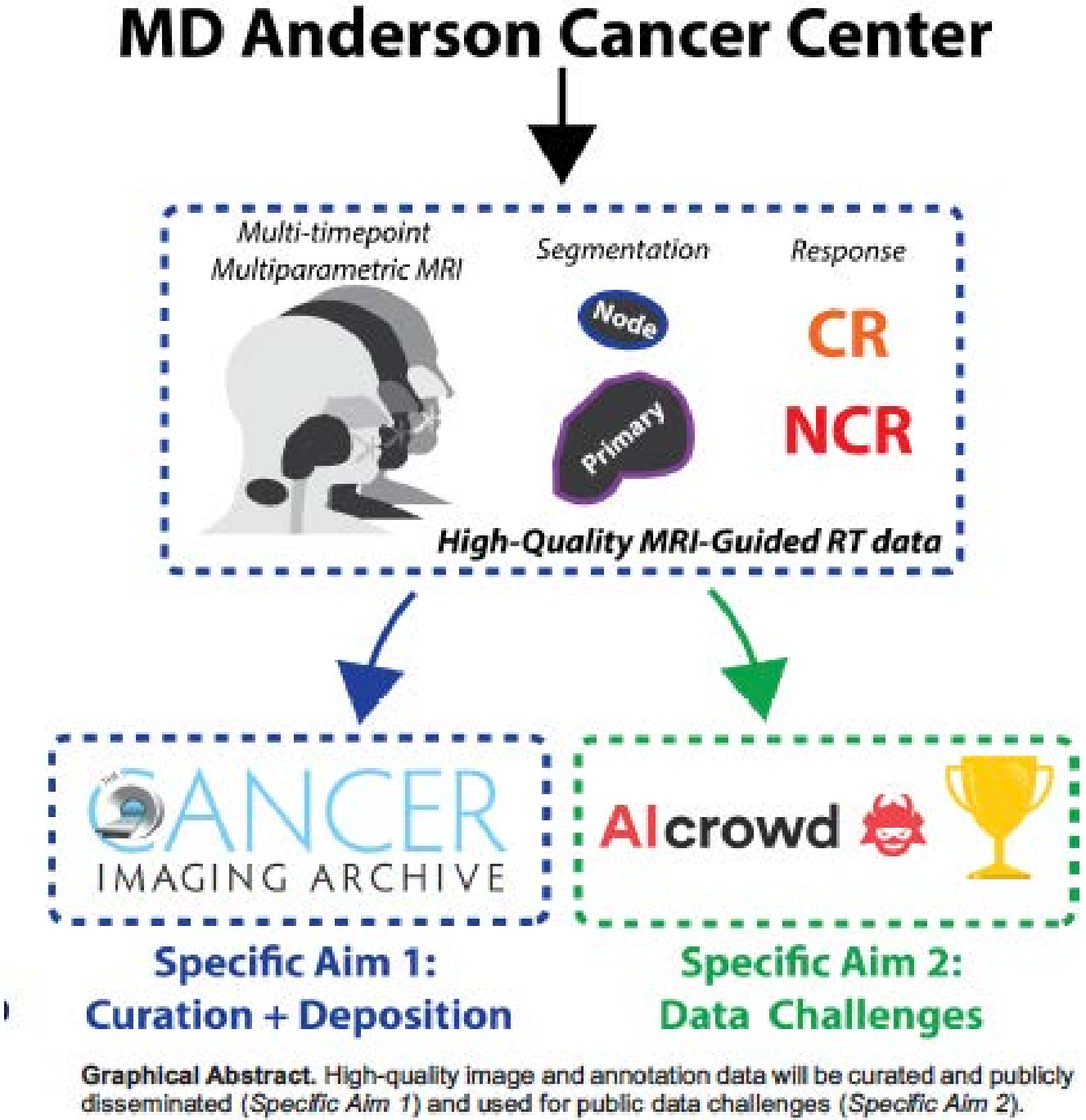
Goals: To develop the hardware, software, technical, and quality assurance infrastructure for functional (diffusion-weighted) imaging-guided RT on the Unity MR-Linac for head and neck cancers







The Parent Project, continued



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*).

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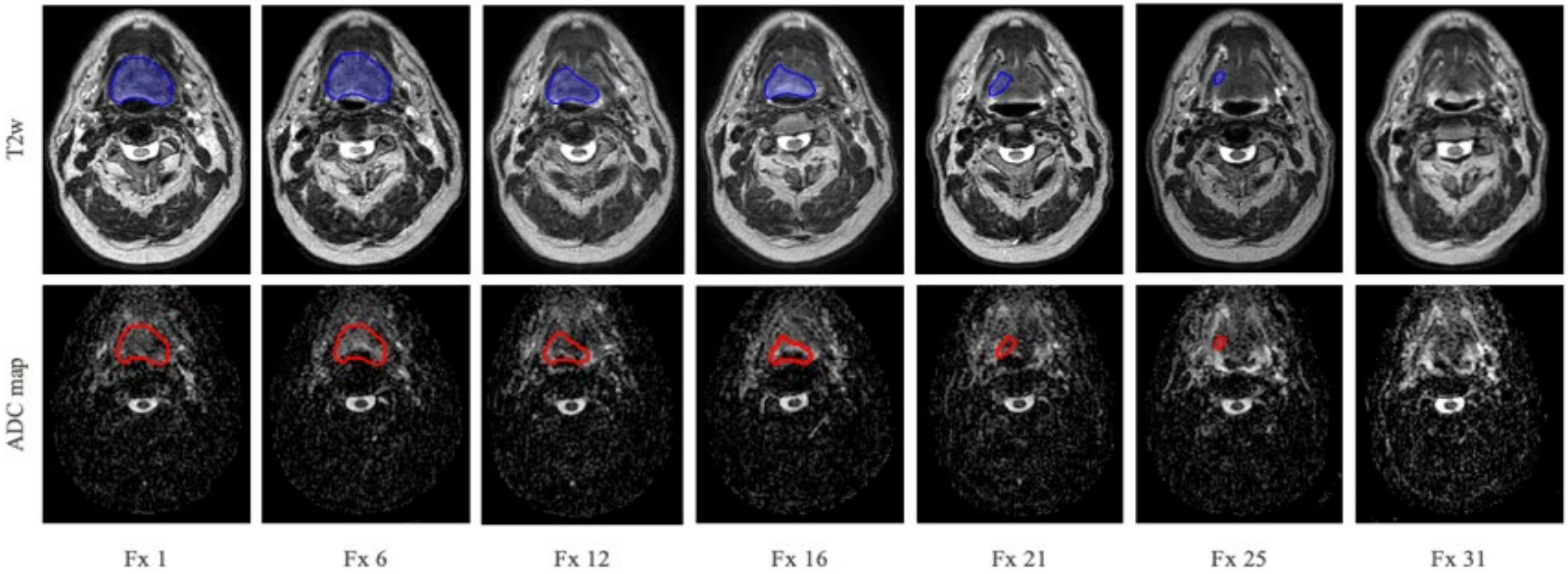
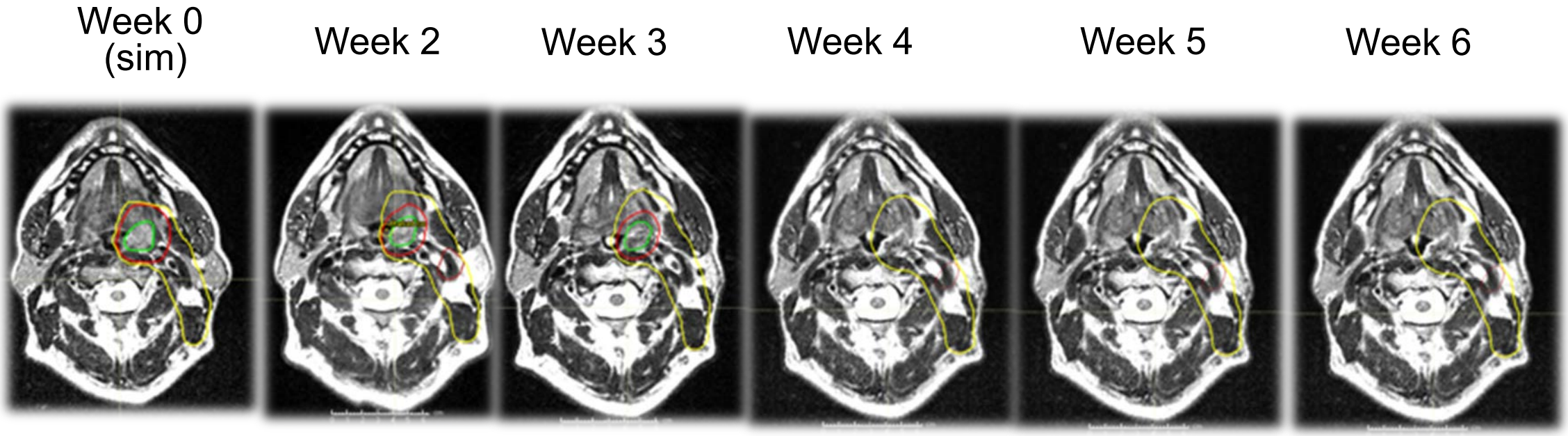
Multi-parametric MRI daily

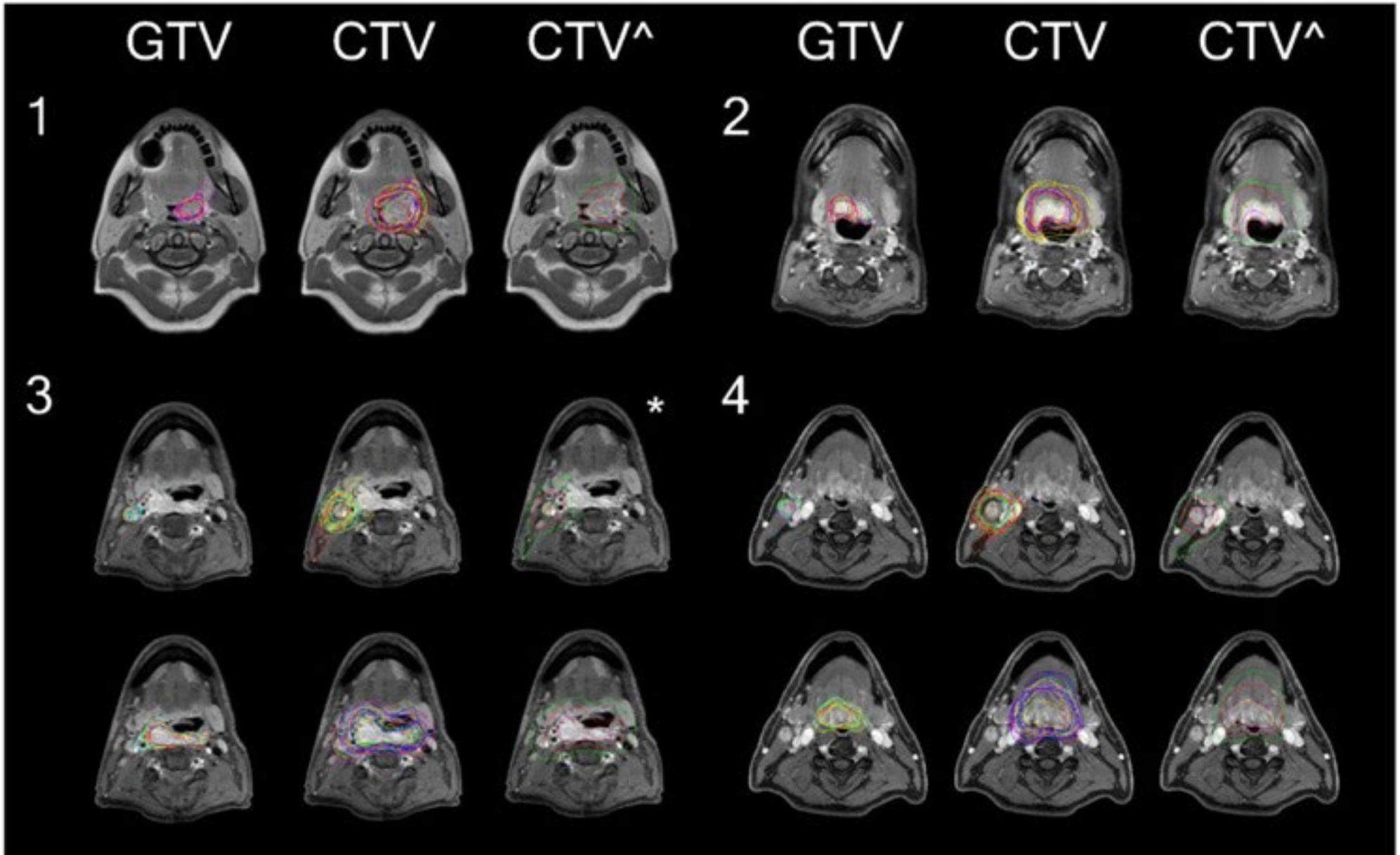


Multi-parametric MRI daily (continued)



Patient # 1- MRgRT weekly dose adaptation

Problem: Segmentation variability over many daily fractions



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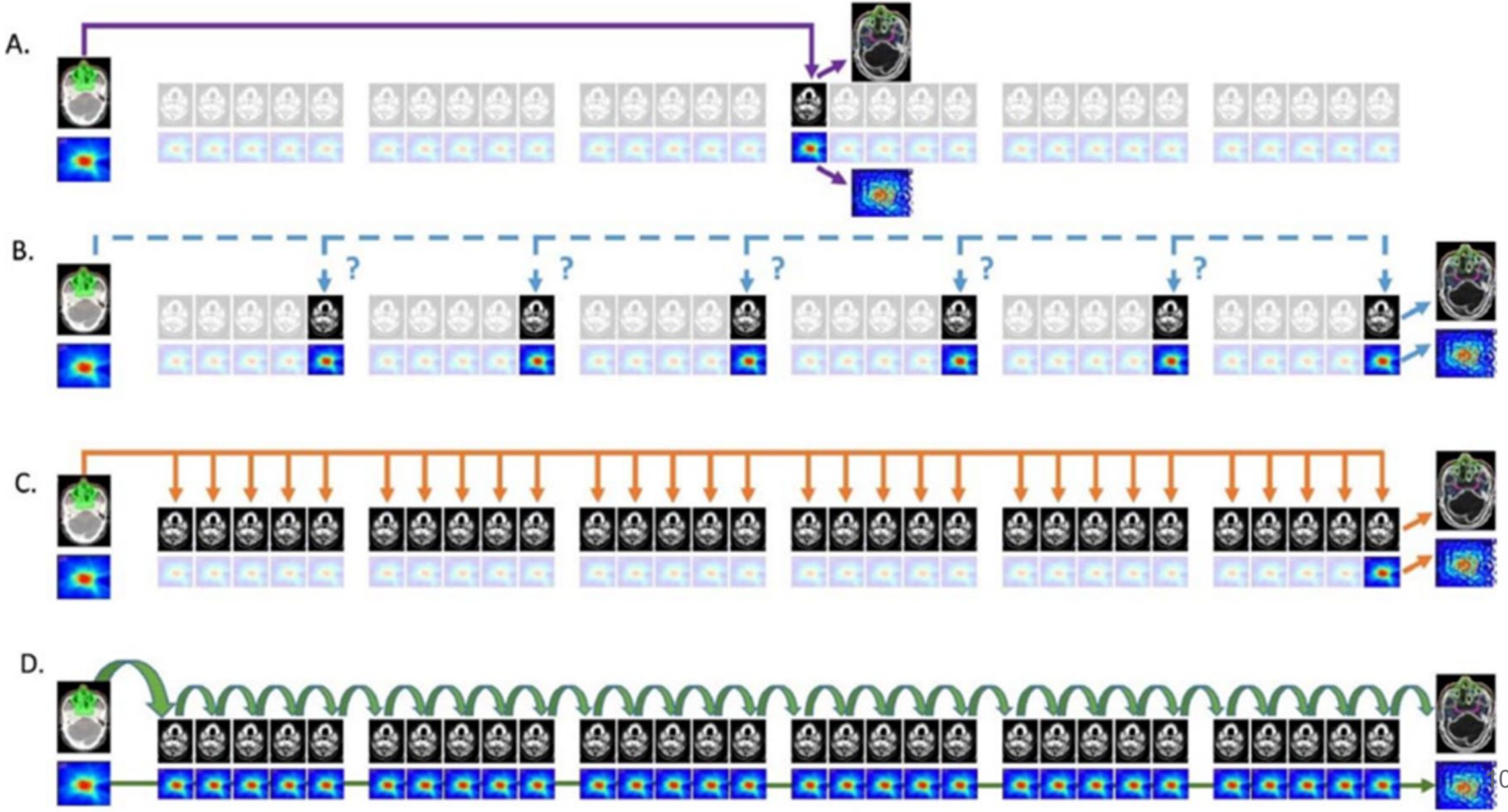
Problem: Segmentation variability over many daily fractions, continued



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

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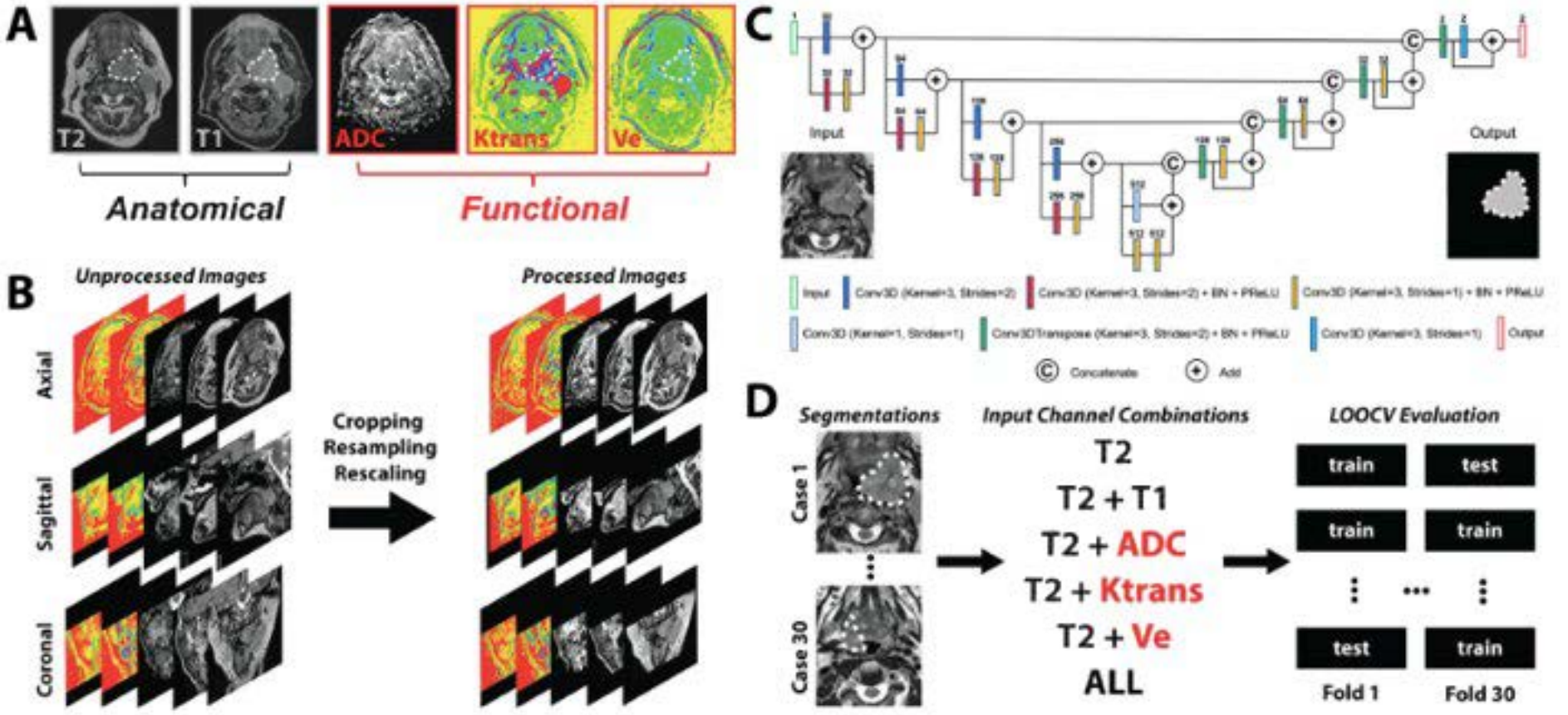

Kareem A. Wahid [a], Sara Ahmed [a], Renjie He [a], Lisanne V. van Dijk [a], Jonas Teuwen [b], Brigid A. McDonald [a], Vivian Salama [a], Abdallah S.R. Mohamed [a], Travis Salzillo [a], Cem Dede [a], Nicolette Taku [a], Stephen Y. Lai [c], Clifton D. Fuller [a], Mohamed A. Naser [a]

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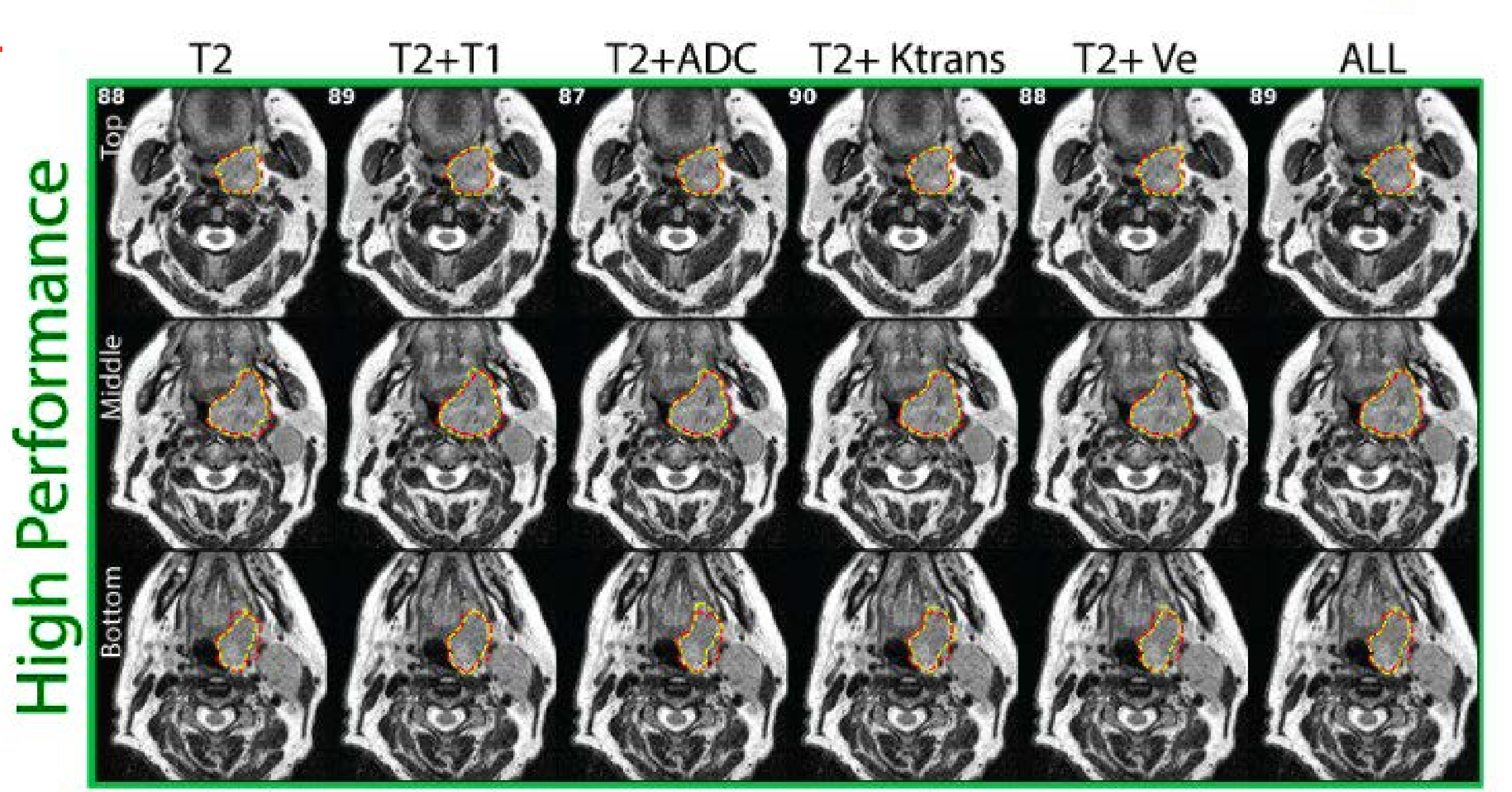
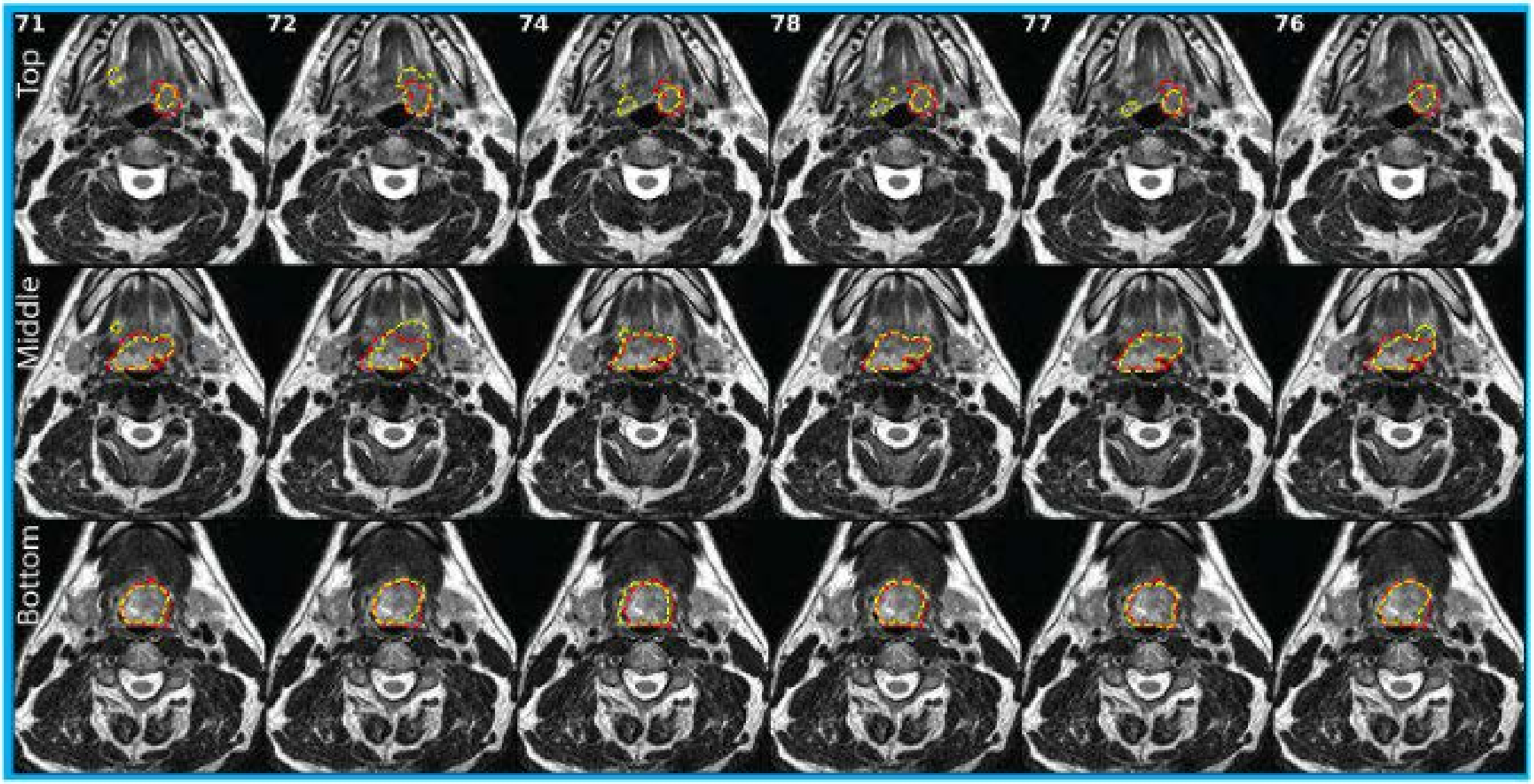
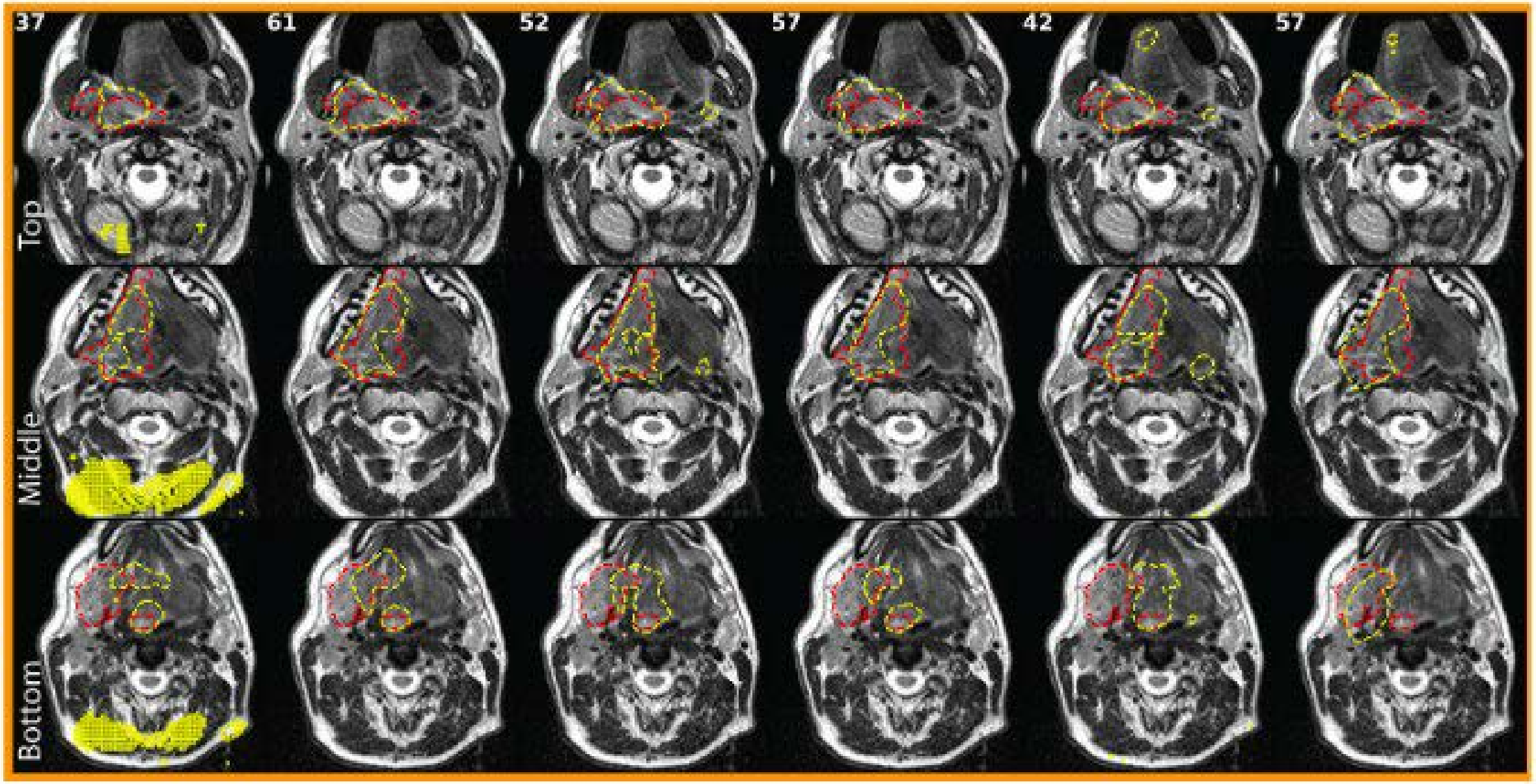

T2
T2+T1
T2+ADC
T2+ Ktrans
T2+ Ve
ALL
High Performance
Top
Middle
Bottom
88
89
87
90
88
89

Medium Performance



Low Performance



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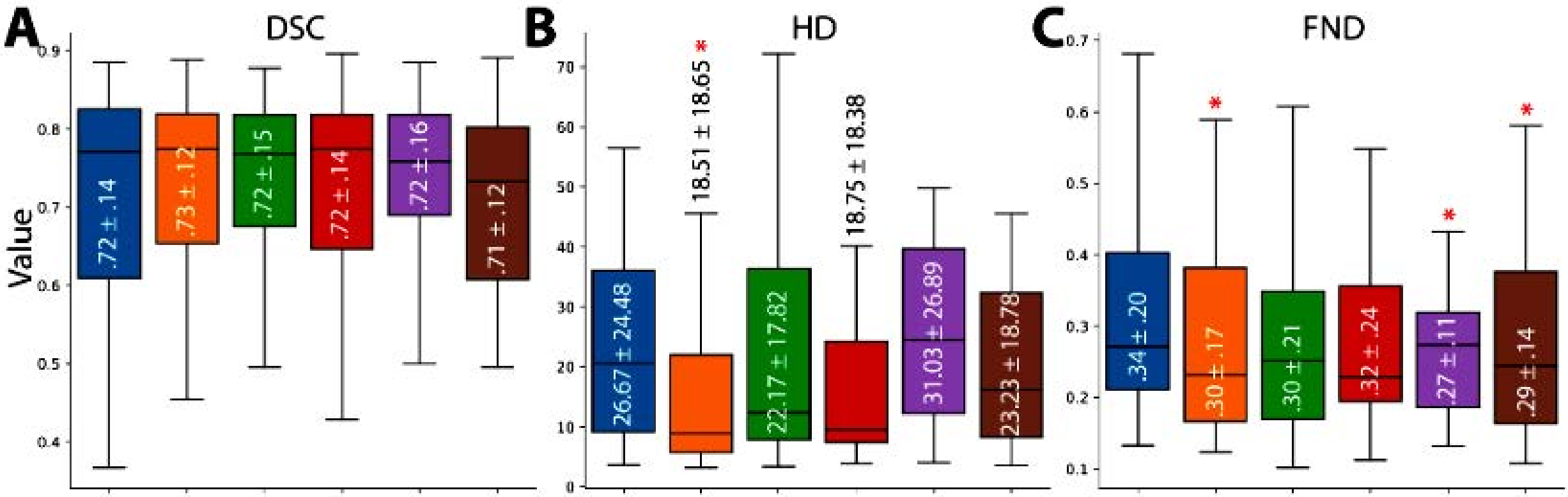

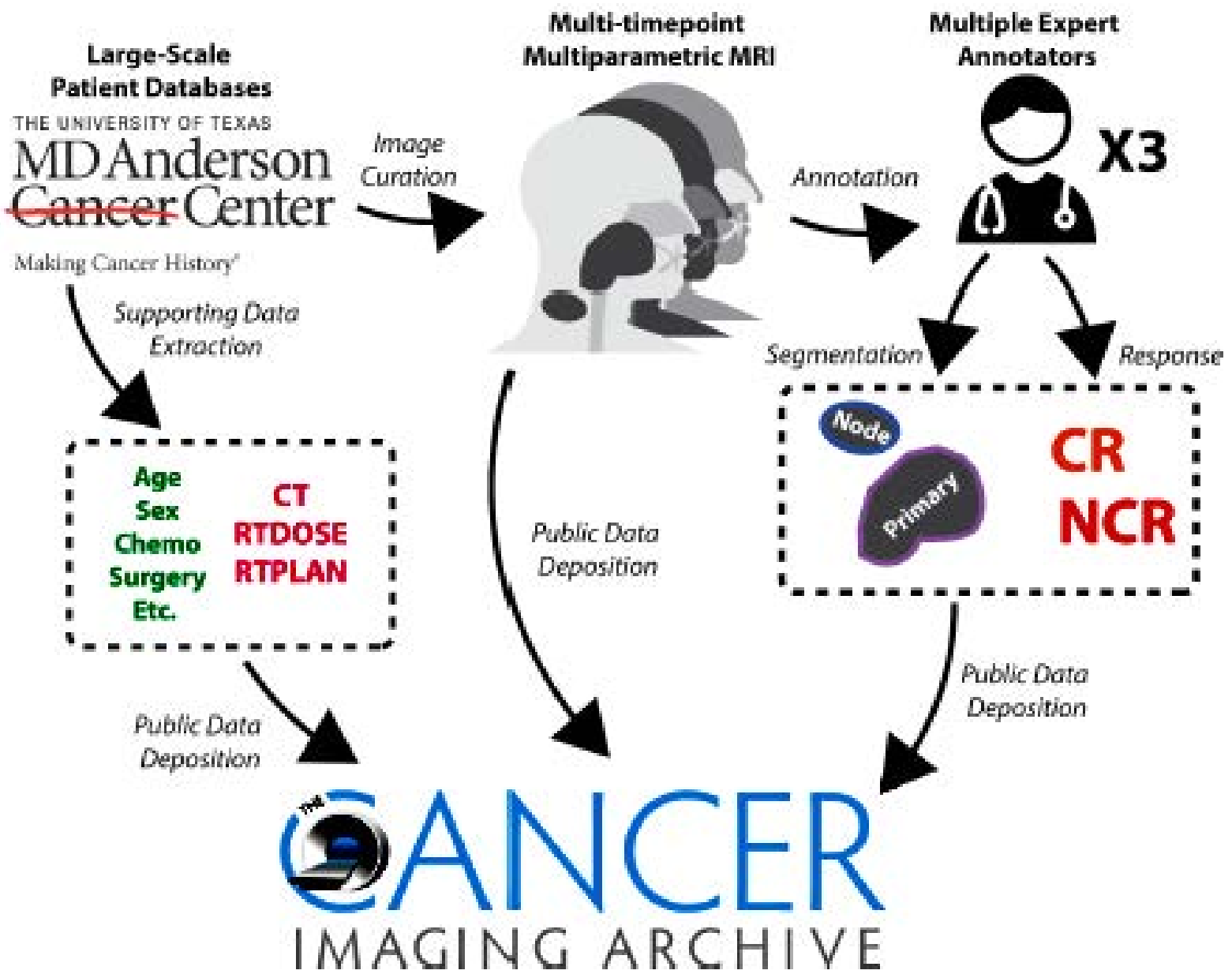

Figure 5. Workflow for Specific Aim 1. We will curate high-quality images, annotations, and supporting data, and subsequently deposit them to public repositories.

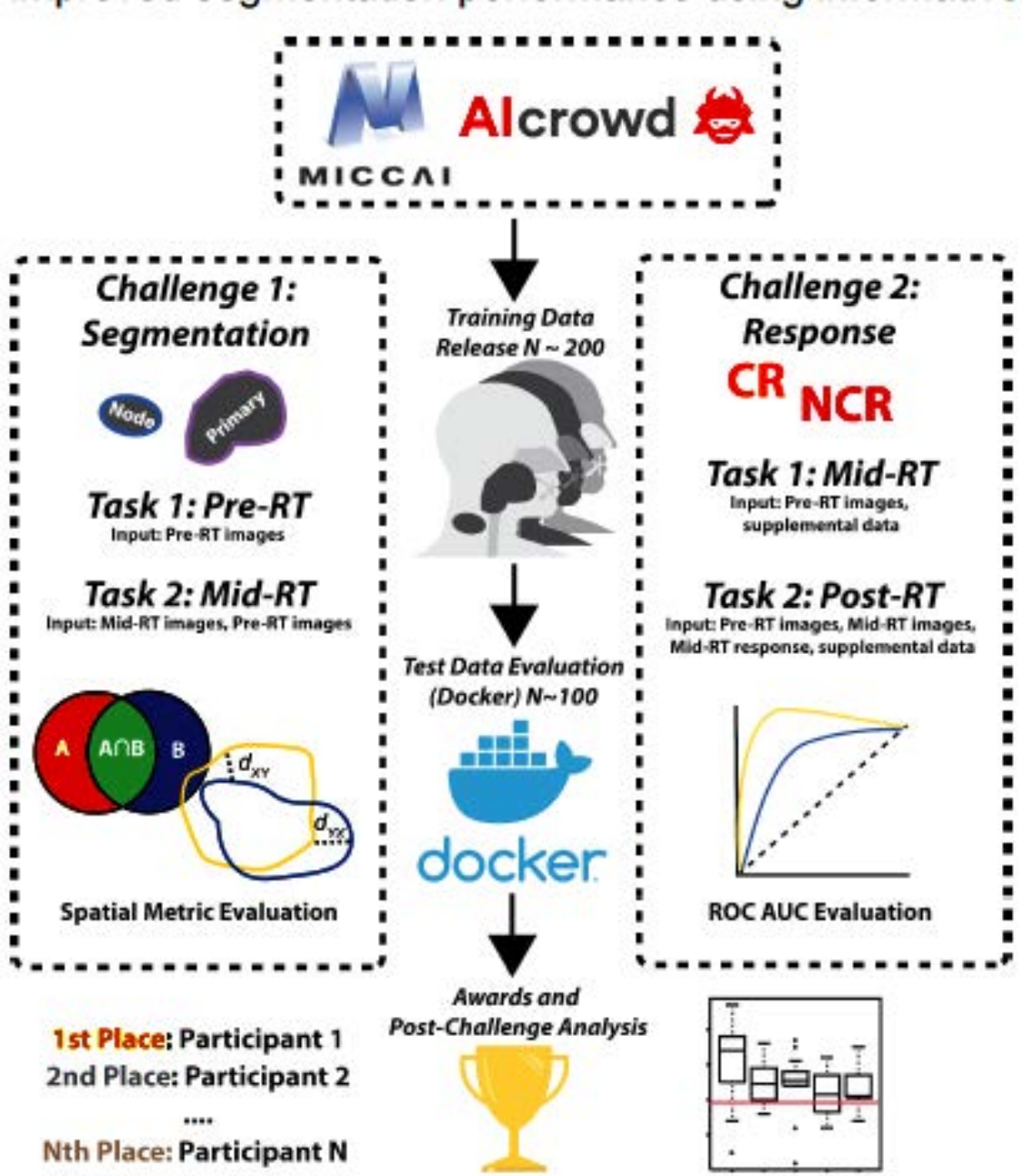

Figure 6. Workflow for Specific Aim 2. We will design Data Challenges based on previously described data to foster community-based AI innovation.

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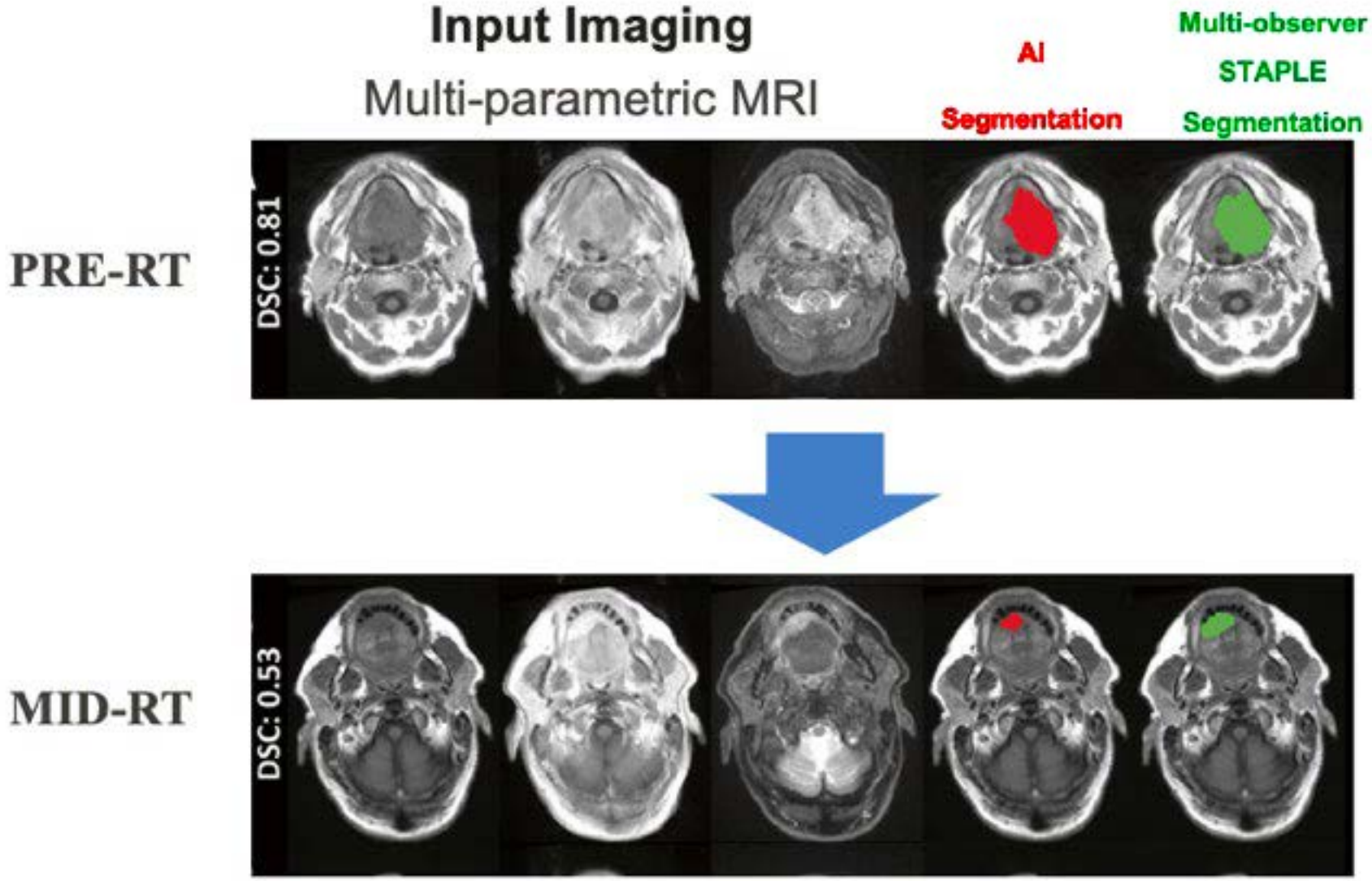
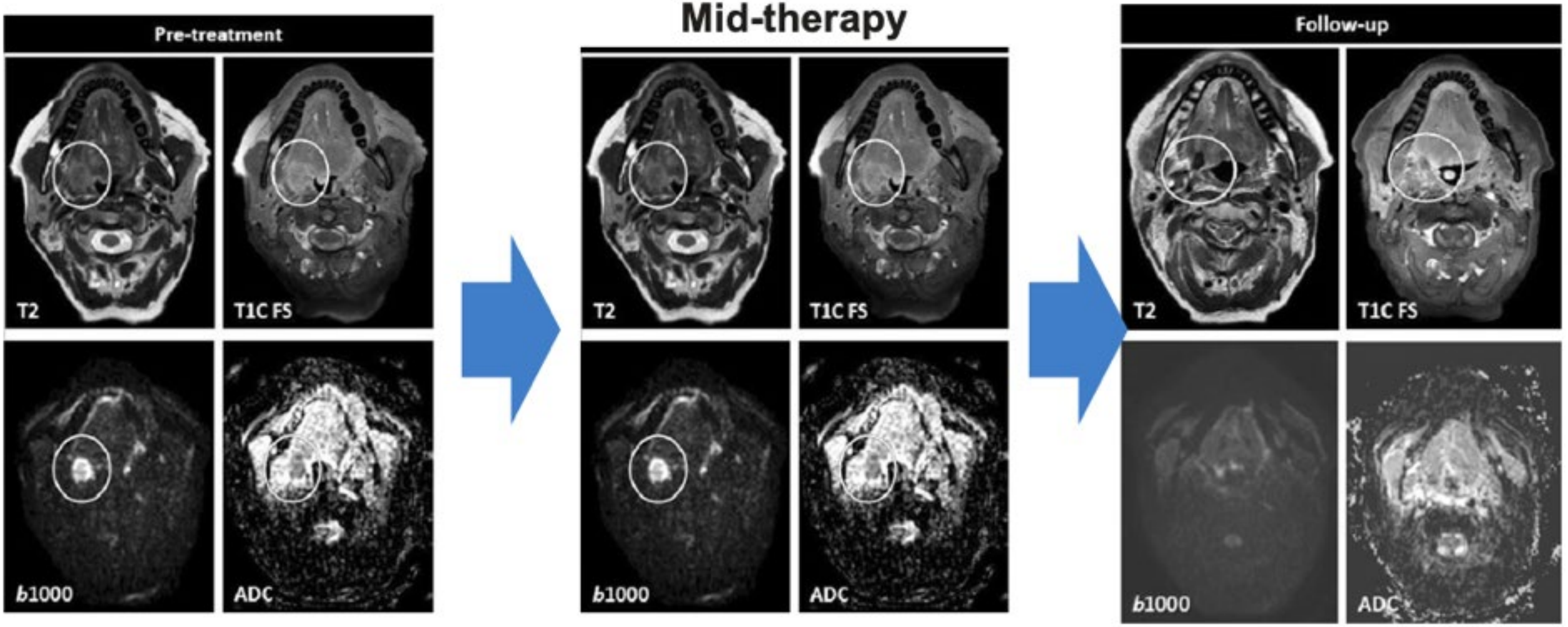
Segment pre- and post-RT images compared to multi-observer consensus



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

Research Outputs

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.
- McDonald BA, Dal Bello R, Fuller CD, Balermpas P. The Use of MR-Guided Radiation Therapy for Head and Neck Cancer and Recommended Reporting Guidance. Semin Radiat Oncol. 2024 Jan;34(1):69-83. doi: 10.1016/j.semradonc.2023.10.003. PMID: 38105096.
- 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

- Fuller, Clifton (2022). "AI", Machine Learning, “Big Data”, Informatics, and Clinical Outcomes--The Future of Innovation in Clinical Radiation Oncology?. figshare. Elekta User Meeting . https://doi.org/10.6084/m9.figshare.21382749.v1
- Fuller, Clifton (2024). 2024 North American Skull Base Society 33rd Annual Meeting s: "CT-to-MR for Head and Neck SBRT Applications" and "Machine Learning in Radiotherapy". figshare. . https://doi.org/10.6084/m9.figshare.25237678.v1
- 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
- Fuller, Clifton (2023). IGCT Seminar: "Pre-Registration, Pre-Prints, Public Access, and FAIR & Open Science: Transparency and Equity in Data-Driven Science”. figshare. . https://doi.org/10.6084/m9.figshare.24029898.v1
- Fuller, Clifton (2023). Algorithmic Biases, FAIRness/Fairness, and Equity - Towards Responsible Accuracy in AI [AAPM PBDW 2023]. figshare. . https://doi.org/10.6084/m9.figshare.22959698.v1

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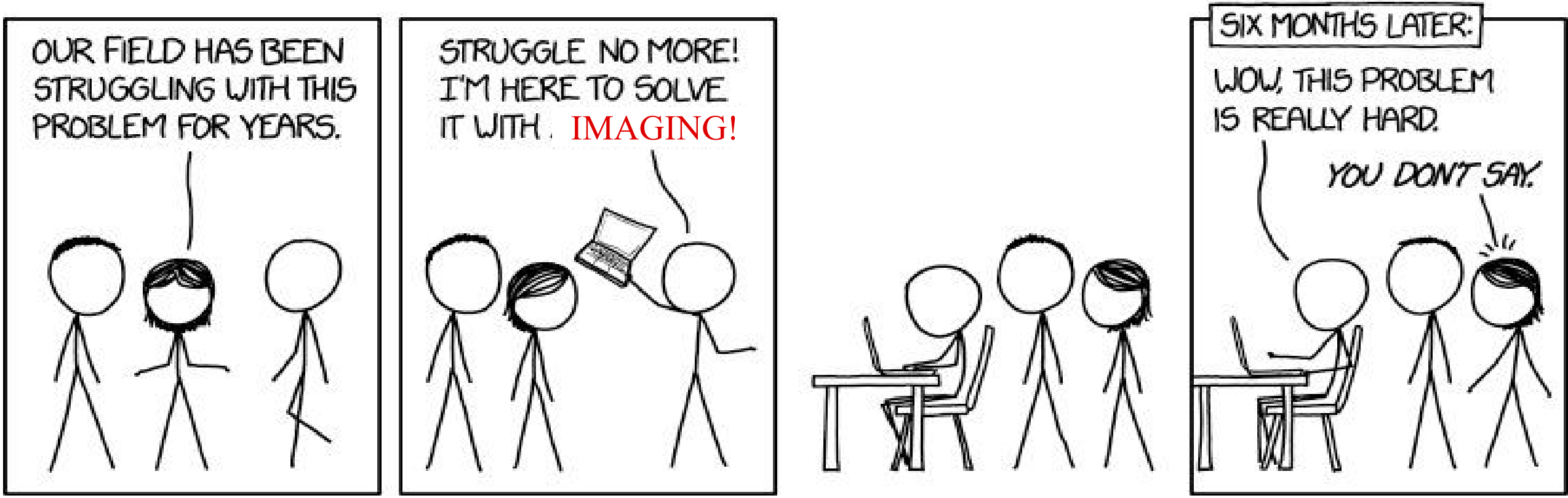

https://xkcd.com/1831/

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