Leveraging Artificial Intelligence (AI) Clinical Decision Support Software to Improve Treatment Plan Quality in Head and Neck Cancer Patients

M. H. Lin[1], Y. K. Park[2], and D. J. Sher[2]; [1]*Department of Radiation Oncology, University of Texas Southwestern Medical Center, Dallas, TX,* [2]*University of Texas Southwestern Medical Center, Dallas, TX*

Purpose/Objective(s): Radiation treatment planning for Head & Neck cancer (HNC) patients is a complex process. Physicians create treatment plan “directives” for dosimetry, but the lowest achievable dose for each individual OAR is unknown a priori. Automated patient matching (PM), a machine learning (ML) technique, identifies previously approved treatment plans that dosimetrically match DVH parameters of target volumes and OARs prior to actual treatment planning. We evaluated the feasibility of AI powered PM to 1) predict and identify lower doses to specific OARs during creation of the Physician Directive (PD) and 2) improve the quality of the final plan.

Materials/Methods: A ML model was created consisting of 376 historical HNC treatment plans approved by 4 Radiation Oncologists at an academic medical center. Treatment plans in the model include Oropharynx (OPC) [n=78], Oral Cavity (OC) [n=86], Larynx (n=66), Salivary (n=11), Nasal Cavity (n=10), Nasopharynx (n=8), Hypopharynx (HPC) [n=6], Paranasal Sinus (n=5) and other (n=106). 19 prospective patients were evaluated consisting of OPC (n=9), Larynx (n=4), OC (n=3), HPC (n=1), HPX/Larynx (n=1) and OC/OPC (n=1); 17 definitive and 2 post-op. Prior to processing each patient, an initial PD was created by a. Utilizing PM, the physician identified a preferred historical match and created a new Hybrid Directive (HD) by choosing certain lower predicted OARs from PM to replace values from the PD. The HD was used to inform dose to the OARs for treatment planning.

Results: For 19 prospective patients, ML consistently predicted lower dose metrics 35-91% of the time across the high impact OAR objectives. ML predicted 61 reduced OARs that were chosen by the physician and incorporated into the HD. Of these, 59 afforded a dose reduction and 2 did not. The average absolute and percent dose reduction to OARs was 5.9 Gy and 19%, respectively; an average of 3.1 OARs were reduced per patient. Two of the 61 dose predictions chosen for the HD did not achieve dose reduction in the final treatment plan: the Superior Right Parotid was optimistic by 1.6Gy in one case, while the Superior Left Parotid was optimistic by 1.7 Gy in the other. The physician provided lower dose to high impact OARs an average of 48% of the time, while ML offered lower dose 54% of the time.

ML vs. Expert Radiation Oncologist

High Impact OARs	% Cases ML Predicts Lower Objective	Average Mean OAR Dose Reduction (Gy)	Average Mean OAR Dose Reduction (%)
Esophagus	35	9.4	26.4
Larynx	67	4.3	13.4
Superior/Middle Constrictor	64	10.2	22.8
Inferior Constrictor	41	6.5	23.8
Parotid	44	3.1	15.4
Superior Parotid	91	4.3	17.8
Submandibular Gland	38	1.7	9.74

Conclusion: Patient matching with decision support software is a promising method to improve the PD, reduce dose to OARs and produce better treatment plans. This hybrid directive technique produced superior plan quality to ML or PD alone. We expect that with the ongoing use of this software, the increased numbers of patients in the database will improve the ML dosimetric insights given to the physician.

Author Disclosure: M. Lin: None. Y. Park: None. D.J. Sher: None.