

## Investigating the impact of avoidance sectors on esophageal radiotherapy plan quality and developing a RapidPlan model for upper, mid, and lower thoracic sites

### Background

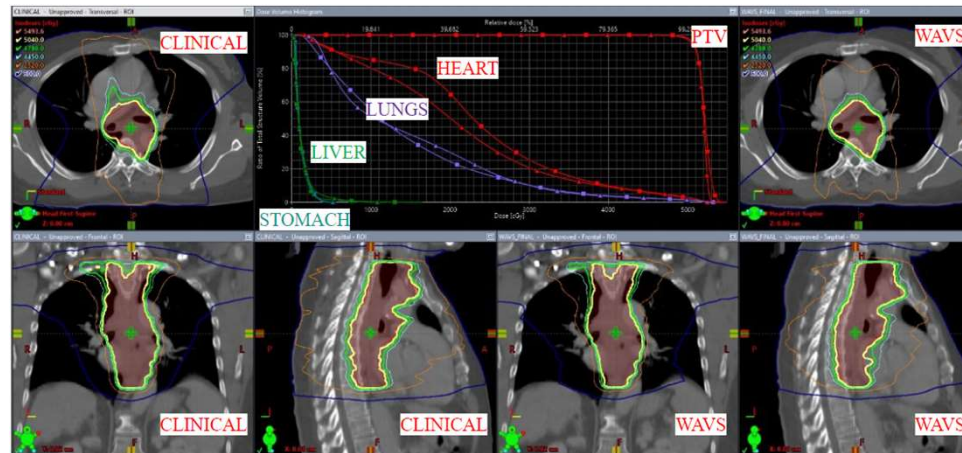
Radiotherapy of the esophagus is challenging as the tumor is surrounded by many organs at risk (OARs) such as the heart, lungs, and spinal cord. Knowledge-based planning approaches to radiotherapy treatment planning have been shown to provide improved plan quality as well as standardization of treatment approaches. Although avoiding beam entrance through the lung reduces low dose, missing control points can potentially increase plan heterogeneity, leading to acute toxicity. The quality of the plans generated from a knowledge-based planning approach depends on the plans that are entered into the model. To the authors' knowledge, no study has yet to quantify the influence of using avoidance sectors while prioritizing improving photon dose homogeneity.

### Purpose

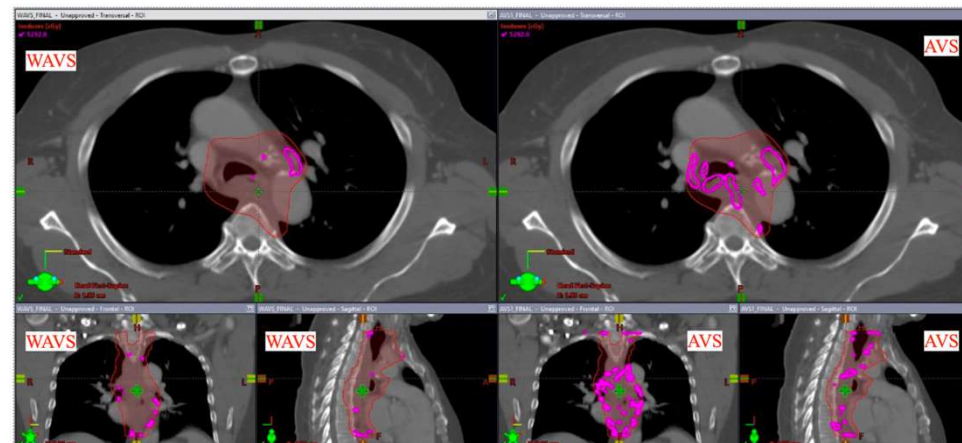
This study addresses the gap in the literature and investigates the role of avoidance sectors on plan quality, while subsequently building a RapidPlan model for upper, mid, and lower thoracic sites. Outcomes may impact the medical dosimetry profession by providing insights into optimizing treatment strategies for improved plan quality and toxicity in patients undergoing esophageal radiotherapy.

### Materials and Methods

Forty-five patients with esophageal tumors underwent treatment planning using volumetric modulated arc therapy (VMAT) with avoidance sectors (AVS) or without avoidance sectors (WAVS). Dosimetric parameters and plan quality were evaluated using Eclipse V15.6 software. A RapidPlan model was developed based on the lower V105%(cc) plans.



**Figure 1.** Comparison of isodose distribution for a mid-esophageal case in the axial, coronal, and sagittal plane for the clinical plan on the left and WAVS plan on the right. The DVH shows a comparison of the two plans, where the clinical plan is in triangles and WAVS in squares. The WAVS plan is more conformal and homogeneous while better sparing the heart. Sparing of the lungs, liver and stomach is comparable.



**Figure 2.** Comparison of V105%(cc) volumes, when using WAVS (6 cc) on the left versus AVS (34 cc) on the right. The prescription dose for this case was 50.4Gy.

### Results

Plans without avoidance sectors significantly reduced PTV V105% (107cc reduction) and improved conformity without compromising target coverage. Lung doses increased slightly (V5Gy by 3.9%) but remained within acceptable limits. Heart sparing improved, while liver doses increased marginally (1.1 Gy). The RapidPlan model constructed from WAVS plans demonstrated improved plan homogeneity and reduced high-dose volumes to the PTV compared to CP and AVS plans. Validation with 22 additional patients confirmed these findings, with WAVS plans showing lower V105%(cc) and improved homogeneity.

### Conclusion

Regardless of thoracic region, WAVS plans significantly improved esophageal plan quality, reduced volumes of the higher doses in the target, and therefore potential likelihood of esophageal toxicity. The RapidPlan model based on WAVS plans demonstrated superior plan homogeneity and reduced high-dose volumes, highlighting the importance of optimizing treatment strategies for improved outcomes in esophageal cancer radiotherapy.

### Author Information

Victoria Olsen, BS, CMD | [Victoria.olsen@stonybrook.edu](mailto:Victoria.olsen@stonybrook.edu)  
Tyler Hwang, BS  
Ting Jiang, BS  
Regina Yu, BS  
Maria Dimopoulos, PhD, MBA, RT(T)  
Vishruta Dumane, PhD, DABR

Follow our Dosimetry Program on Instagram searching the handle @MountSinaiRTTedu