# Dosimetric Analysis of OARnet Auto-delineations for Head and Neck Organs-at-risk

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## INTRODUCTION

Geometric similarity evaluation of alternative delineations yields insufficient information regarding the clinical utility of the delineation. To provide clinical utility, this study evaluates the dosimetric consequence of alternative delineations for state-of-the-art AI based auto-segmentation techniques. The dosimetric robustness of delineations based on deep neural net architectures is investigated with respect to the probability thresholding level.

## AIM

To assess the dosimetric robustness of delineations created via OARnet in comparison with UaNet for head and neck (H&N) organs-at-risk (OARs) in radiation therapy treatment plans.

## METHOD

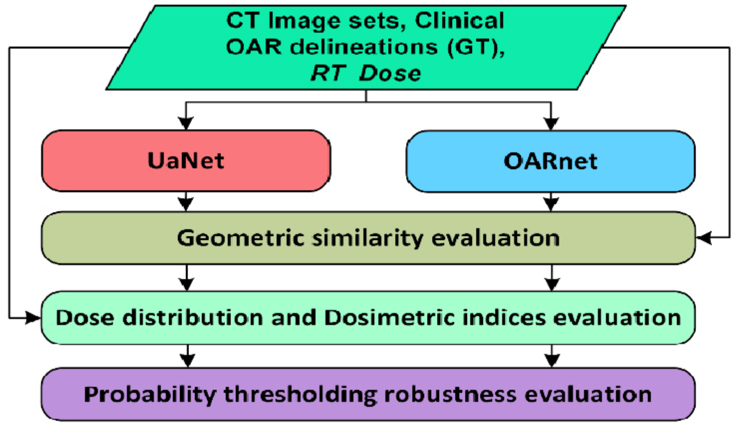


Fig1. Flowchart of research methodology

- Both deep learning-based methods (UaNet and OARnet) were trained on:
  - 235 publicly available H&N CTs
  - 28 OARs manually-delineated
  - 165 datasets are used for training, and 70 for assessment
- Delineation variability is simulated by utilizing different threshold values for the resultant probability map of each OAR.
- Two performance metrics Dice similarity coefficient (DC) and Hausdorf distance 95th percentile (HD95) were used for geometric analysis.
- Dosimetric consequence of the resultant delineations are evaluated by comparing reference DVHs from the treatment plan with the 95% confidence interval bands of DVHs resulting from alternative OARs derived from UaNet and OARnet probability maps.

## RESULTS AND CONCLUSION

**Geometric similarity evaluation of resultant delineation**

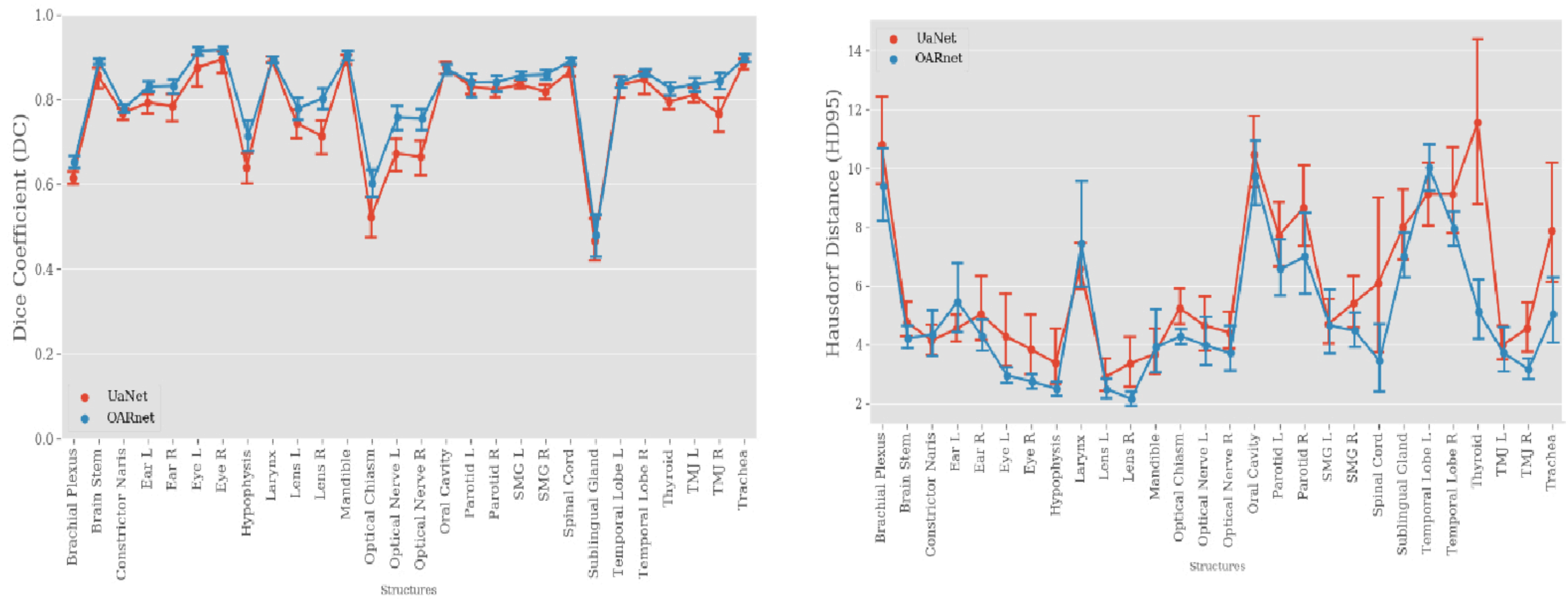


Fig2. Dice coefficient and Hausdorf distance comparison between UaNet and OARnet (the points are mean values and bar graphs show 95% confidence intervals).

**Dose distribution and dosimetric index evaluations**

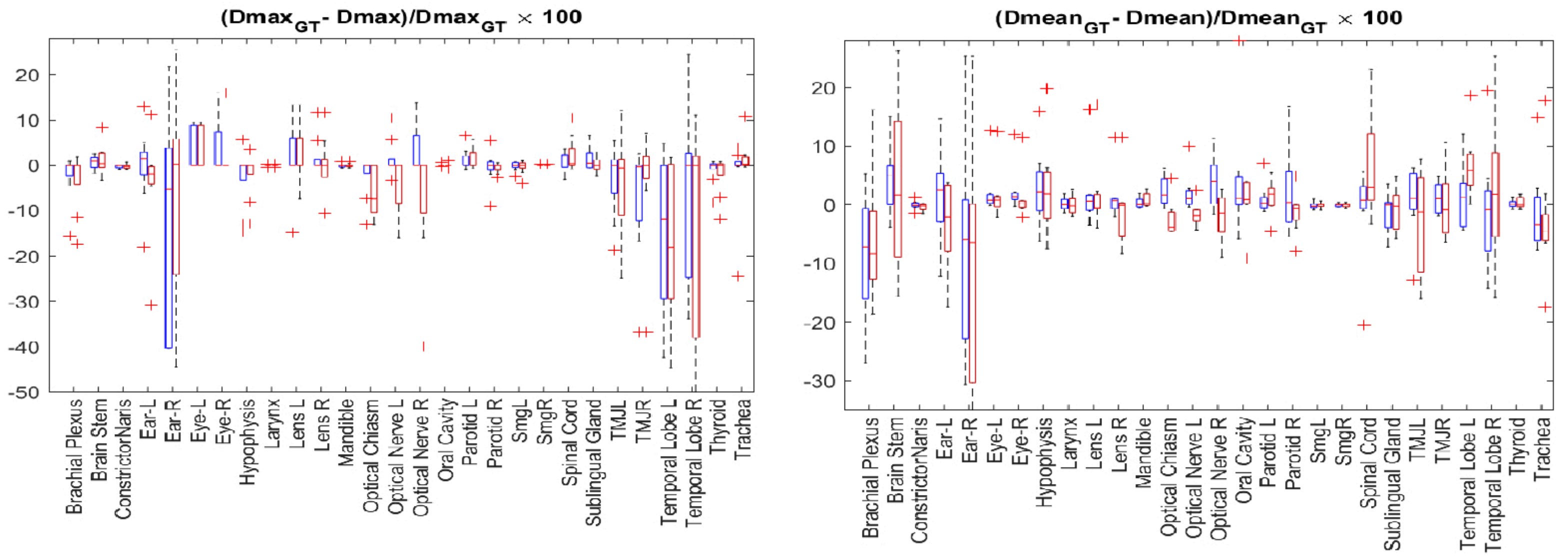


Fig3. Percentage error distribution of max and mean dose indices for 9 patients from the cohort with RT dose

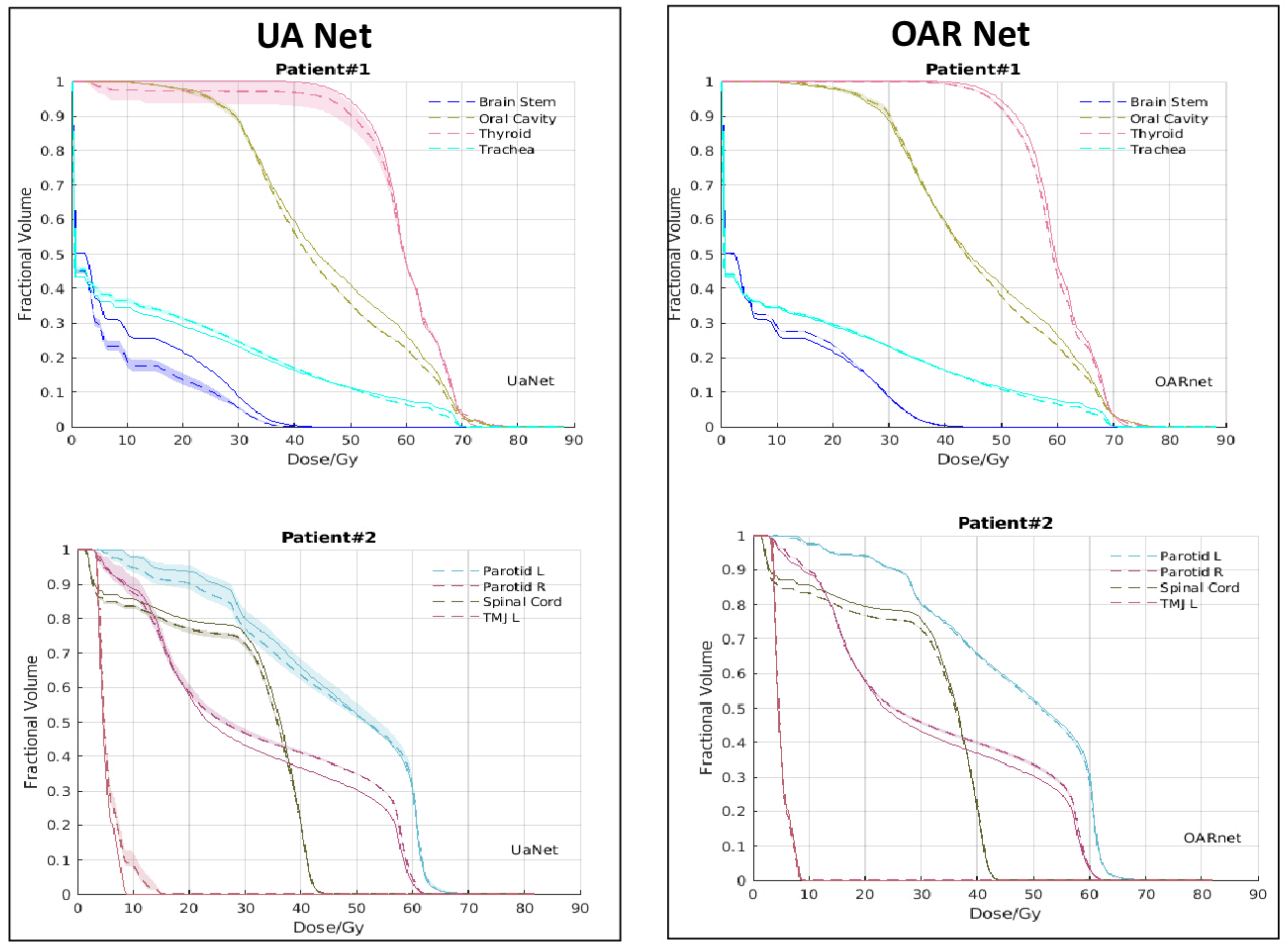


Fig4. Dosimetric quantification using the mean DVHs (dashed line) and their corresponding 95% confidence interval bands from different simulated boolean images from the predicted probability by UaNet and OARnet compared with the DVHs from the plan (solid line)

- Fig4. depicts the dosimetric analysis of a patient with UaNet and OARnet delineations with different threshold values for resultant probability maps. The 95th confidence interval of each DVH indicates less overall dosimetric variability with respect to DVHs obtained from the corresponding ground truth delineations.
- This indicates that OARnet is more consistent or more robust to deviation in threshold values. This ultimately helps to devise probabilistic DNNs with the suggested OARnet architecture.

## ACKNOWLEDGEMENTS

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## REFERENCES

H. Tang, X. Chen, Y. Liu, Z. Lu, J. You, M. Yang, et al. Clinically applicable deep learning framework for organs at risk delineation in CT images, Nature Mach Intelligence, 1 (2019), pp. 480-491.

## CONTACT INFORMATION

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