

Deep-Learning Algorithms for PSMA-PET Image Segmentation: The Effect of Grouping Data

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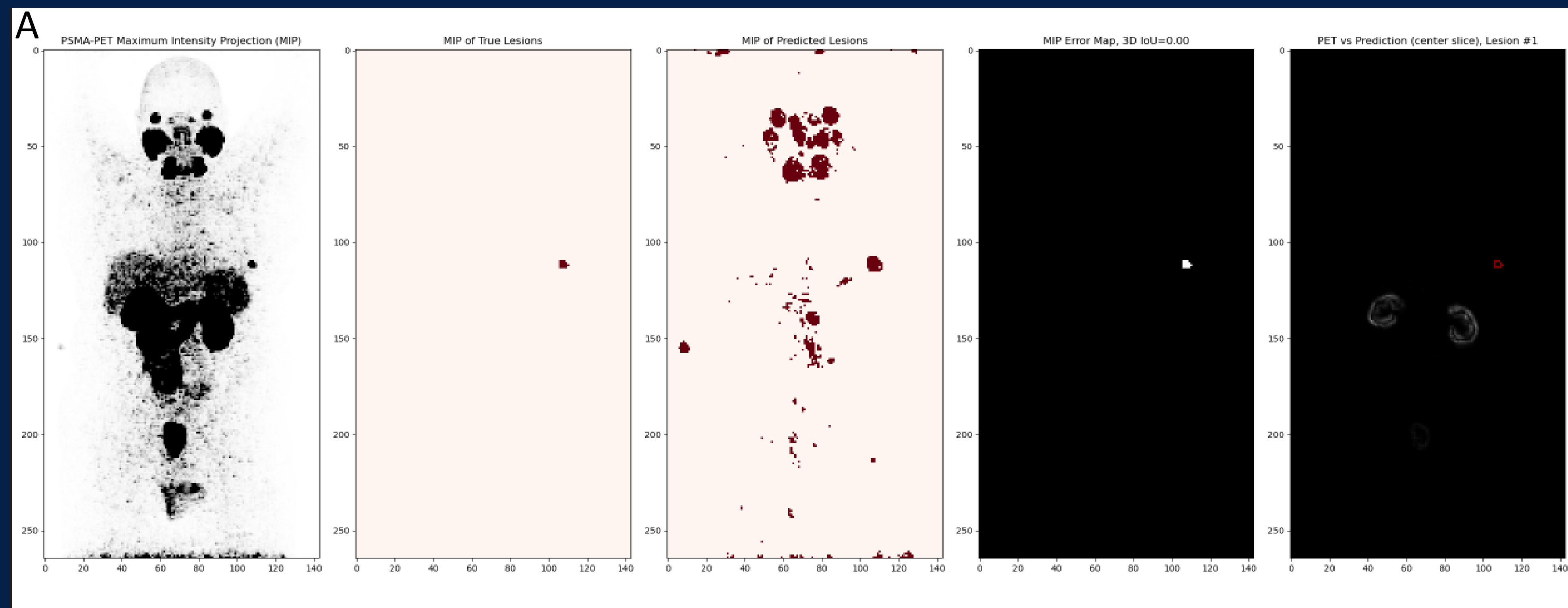
BACKGROUND

- Prostate Cancer – Most common cancer in men, 3rd most common cancer death for men.
- ⁶⁸Ga-PSMA-11 PET: PET radiotracer that binds to prostate cancer cell surface protein
- **Need 1:** Tool to accurately identify & quantify cancer vs. normal uptake in PSMA-PET reconstruction
- **Need 2:** Better understanding of what details of PSMA-PET can be used to predict cancer progression & treatment response

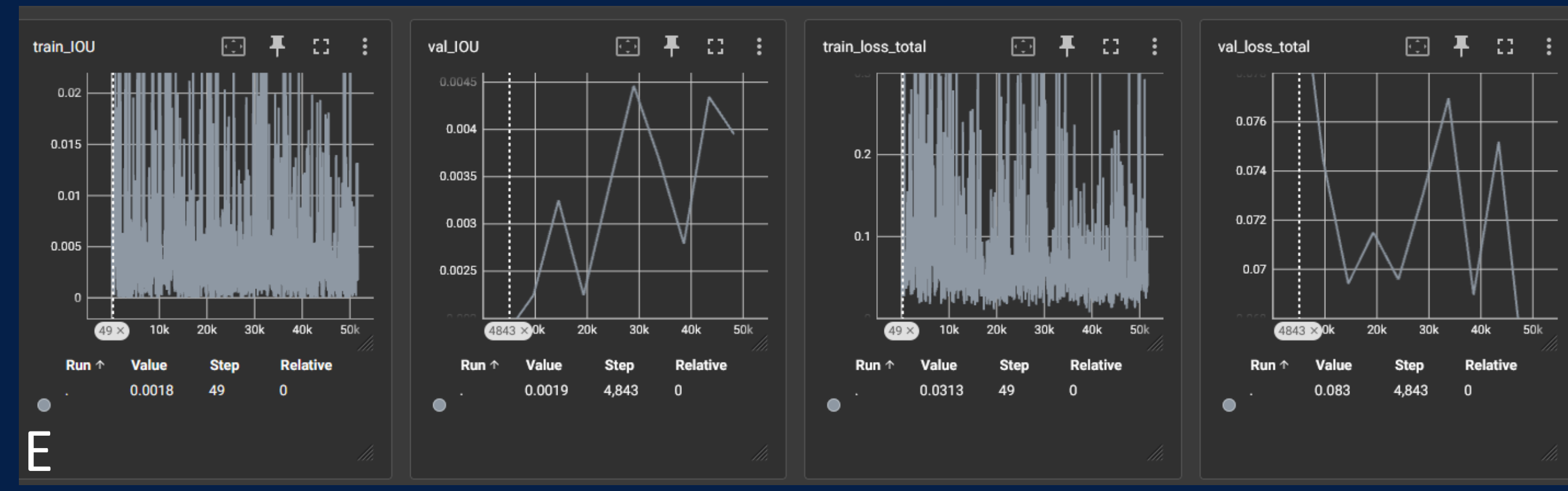
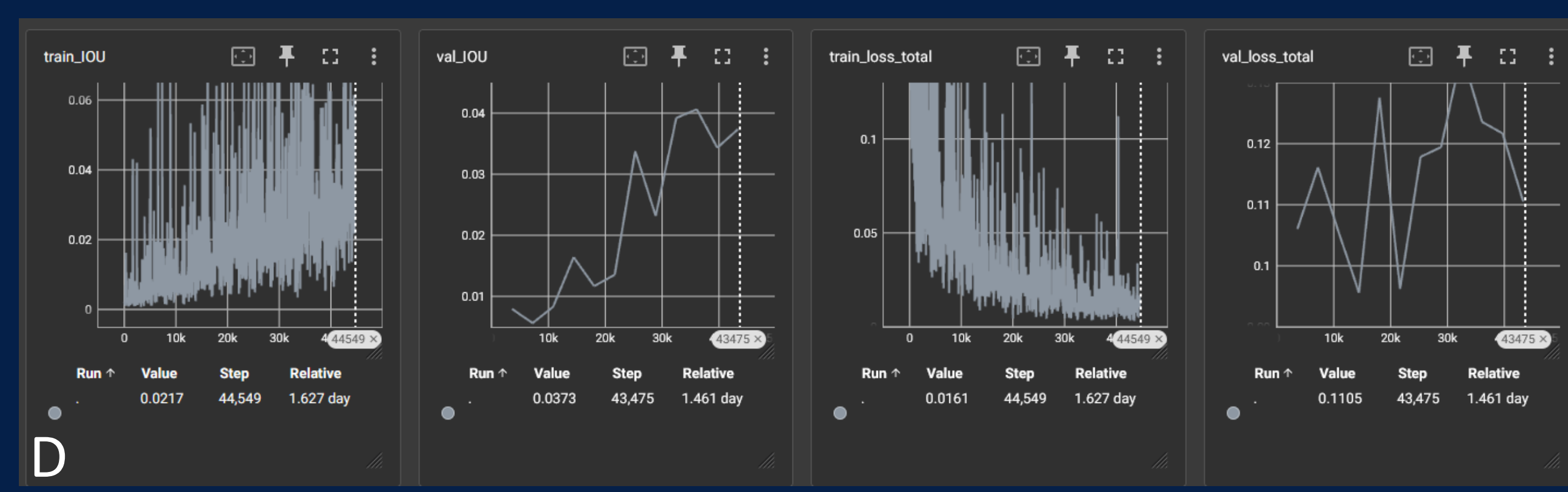
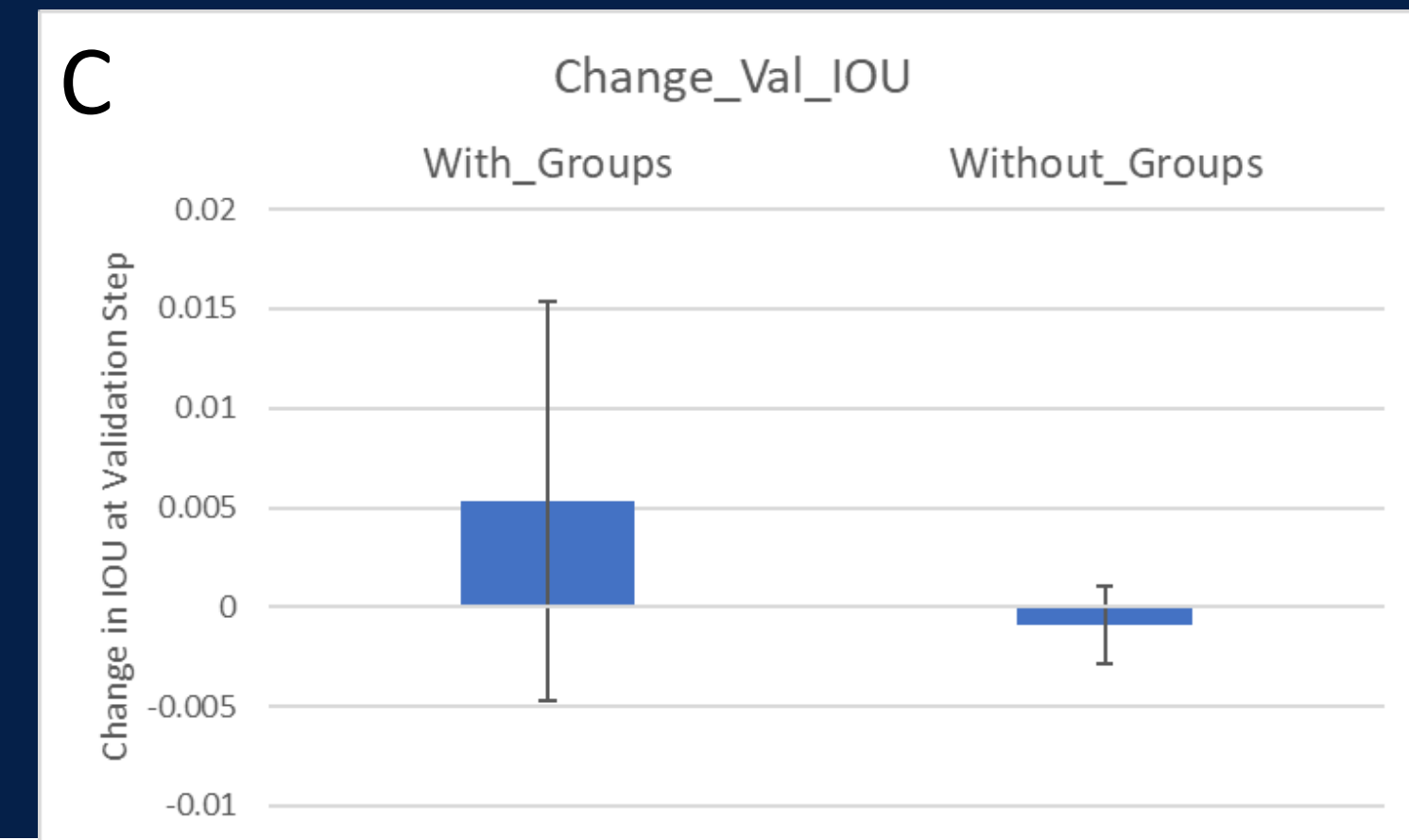
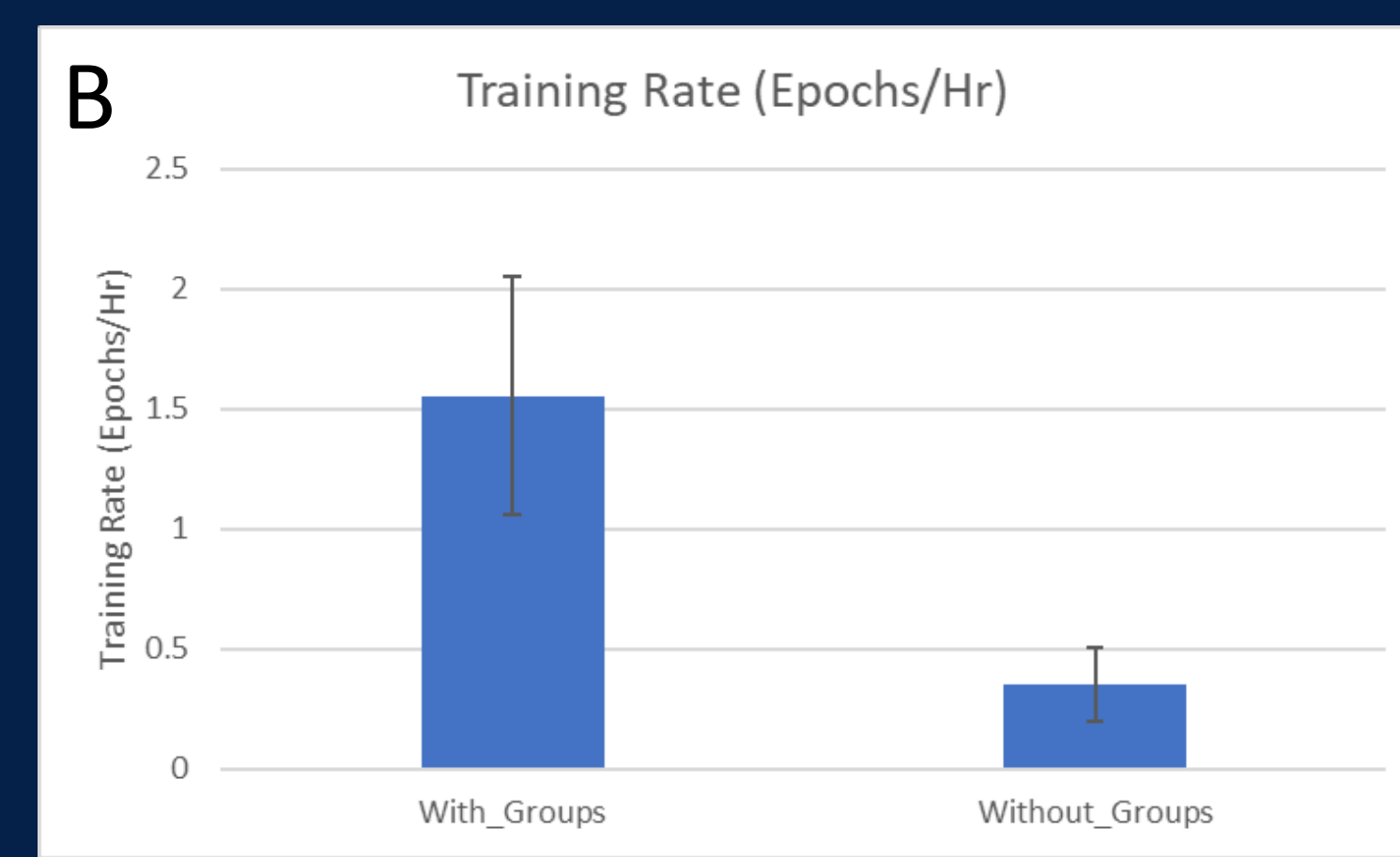
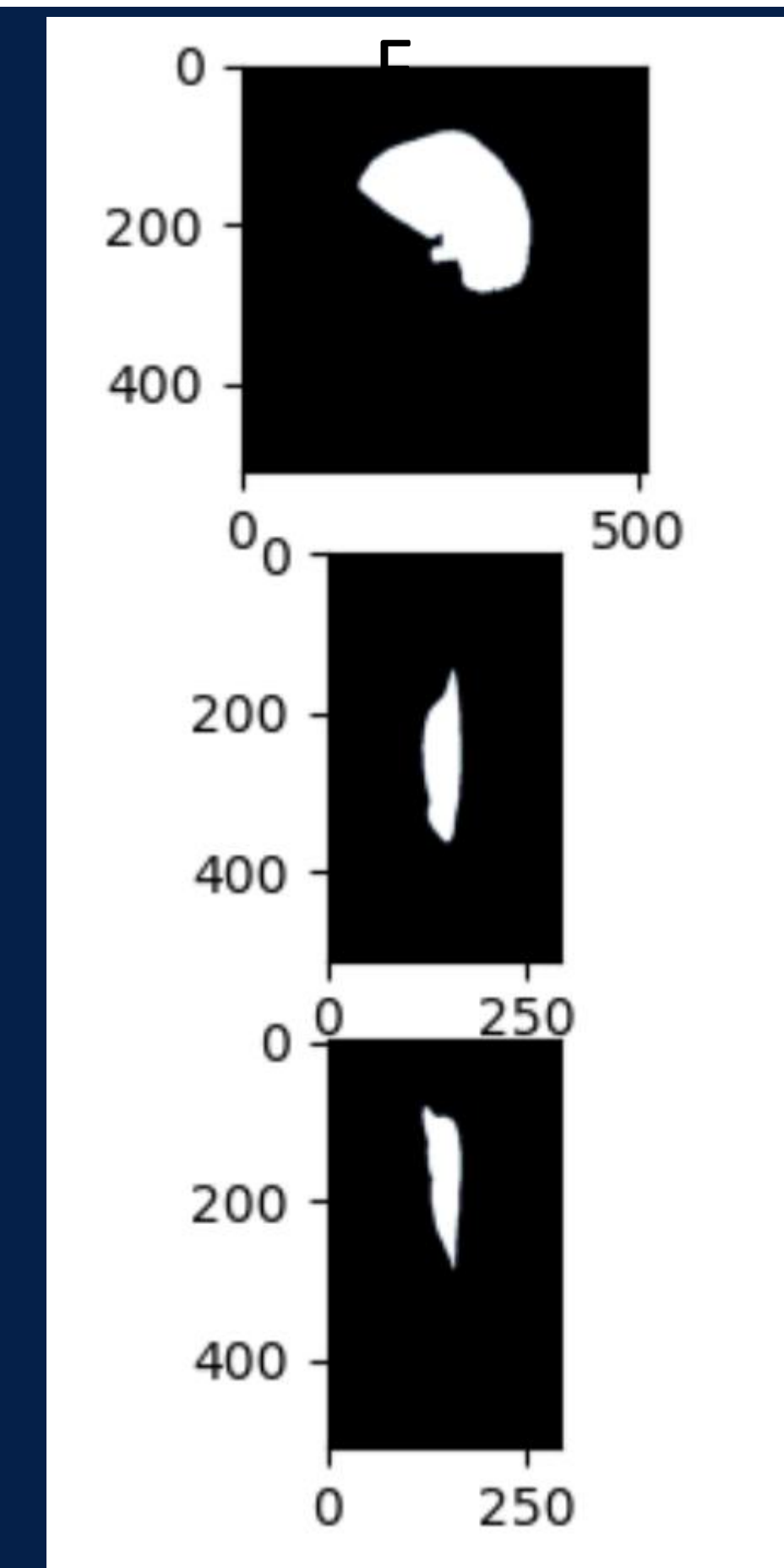
METHODS

1. Collected 217 PSMA-PET positive PET/CT studies from patient & gold standard lesion segmentations
2. Trained 3D UNet on train & validation subsets of data **with and without groups**:
 1. SUV_Max > Avg_SUV
 2. Lesion_Vol > Avg_Lesion_Vol
 3. Mask_Present: True or False
3. Visualized current state of training the model
4. Calculated error metrics for the model, including Intersection of Union (IOU)

Results



- Performed 17 experiments, 8 with groups, and 9 without
- Average length 37 hrs computation, 28.4 epochs
- A: Example PET MIP, Segmented Lesion MIP, Model Prediction MIP, MIP Error, and PET overlay on error
- B: Average training rate $\pm$ SD ($p = 0.00014$)
- C: Average change in IOU at validation step ($p = 0.0729$)
- D: Example training & validation curves for with groups (12 epochs over 39 hrs)
- E: Example training & validation curves for without_groups (10 epochs over 48 hrs)
- F: Example segmentation of liver from a PET/CT for future training use



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DISCUSSION

- We are refining a PMSA-PET segmentation model that can adequately distinguish normal uptake from cancerous lesion
- Training with different groups:
 - we can train the model faster and more efficiently
 - avoid true random subsampling of the PET mask image that results in selecting too much false positive signal
 - allow for training on completely negative PET scans
 - likely improve the IOU error with further experiments and improvement of training
- Working on implementing CT segmentation to allow for easier model segmentation of normal PET uptake
- 600+ new PET-CTs ready for radiologist segmentation & training

ACKNOWLEDGEMENTS

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