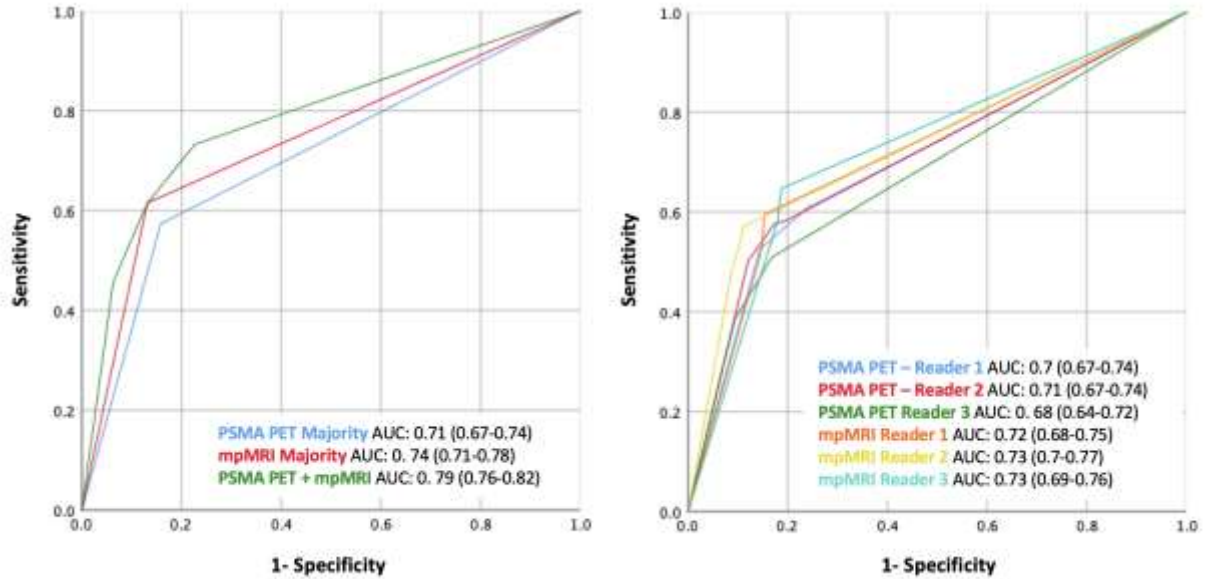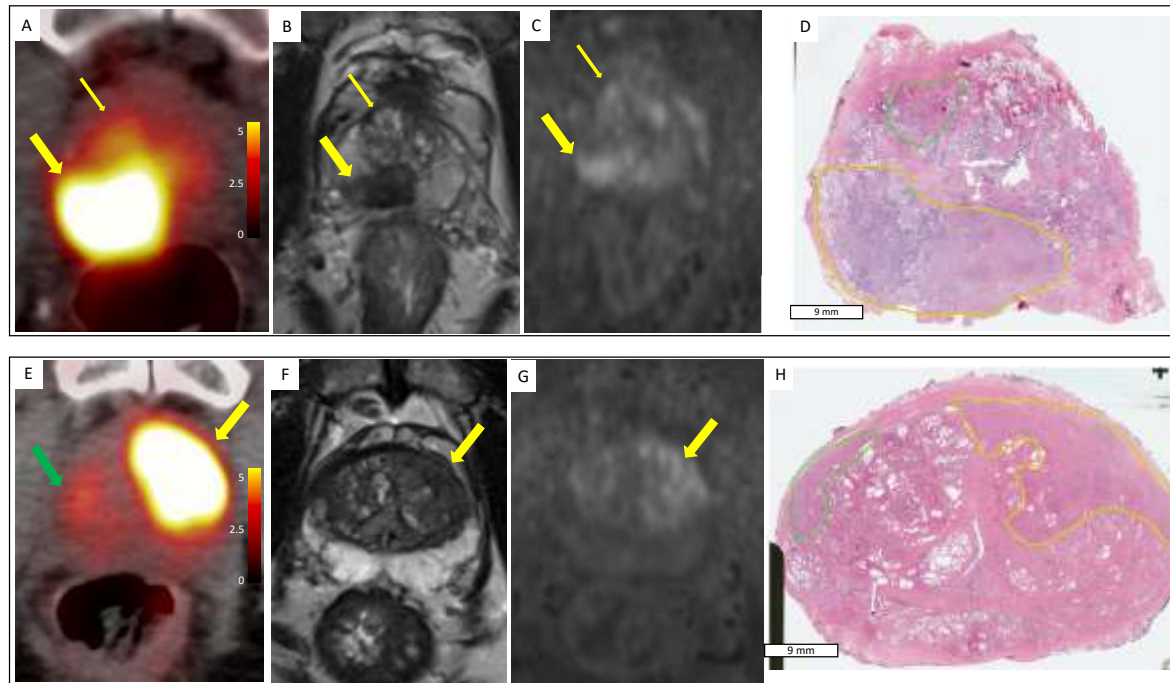**Supplemental Figure 1:** Receiver operating characteristic (ROC) curves for the segment-level analysis for clinically significant lesions (excluding Gleason score 3+3=6) obtained using a binary score for the PSMA PET/CT and mpMRI majority reads (left), using the 1-to-5 PSMA and PI-RADS scores for each individual reader (right).

Supplemental Figure 2: Two case examples from our cohort.

(Top row) 61-year-old patient (#23) with biopsy-proven prostate cancer Gleason Score of 4+5=9 and PSA of 11.6 ng/ml at time of PSMA PET/CT. (A) Transverse PSMA PET/CT, (B) T2weighted MRI images show a large PSMA-avid and hypointense lesion, respectively encompassing the right-posterior/left-posterior (large yellow arrow) and right-anterior midgland (small yellow arrow). (C) high b-value diffusion-weighted (DWI) MR images show diffusion restriction in the same location. Whole mount pathology (D) shows two lesions located in the right-posterior/left-posterior midgland (Gleason Score 4+5=9 - contoured in yellow) and right-anterior midgland (Gleason Score 3+4=7 - contoured in green), respectively. This is an example of two lesions on pathology described as a single large lesion by both imaging modalities (two true positive findings – as yellow and green lesions were both described as positive for cancer by both imaging modalities).

(Bottom row) 68-year-old patient (#28) with biopsy-proven prostate cancer Gleason Score of 4+3=7 and PSA of 32.8 ng/ml at time of PSMA PET/CT. (E) Transverse PSMA PET/CT shows a lesion with intense PSMA uptake encompassing the left-anterior/left-posterior base (yellow arrow) and a smaller lesion with mild PSMA uptake located between the anterior- and posterior-right base (green arrow), T2weighted (F) and DWI MR images (G) show a hypointense lesion and diffusion restriction, respectively in the left-anterior base (yellow arrow). Whole mount pathology (H) shows two lesions respectively located in the left-anterior/left-posterior base (contoured in yellow) with Gleason Score 4+5=9, and in the right-anterior base (contoured in green) with Gleason Score 3+3=6. Despite mild PSMA uptake is visible in the right-anterior/posterior base lesion, only one of the three PSMA readers gave it a positive PSMA score and was therefore considered a false negative for both imaging modalities.

Supplemental Table 1: Prostate cancer detection on a lesion-level for each reader.
* McNemar test: p <0.05
PPV= positive predictive value

	PSMA PET/CT			MPMRI		
	Reader 1	Reader 2	Reader 3	Reader 1	Reader 2	Reader 3
INDEX LESIONS	74/74 (100%)	73/74 (99%)	73/74 (99%)	71/74 (96%)	72/74 (97%)	71/74 (96%)
SECONDARY LESIONS	20/32 (63%)	17/32 (53%)	17/32 (53%)	16/32 (50%)	19/32 (59%)	22/32 (69%)
TERTIARY LESIONS	0/3 (0%)	0/3 (0%)	0/3 (0%)	0/3 (0%)	0/3 (0%)	0/3 (0%)
OVERALL (SENSITIVITY)	**90/109 (83%)**	**94/109 (86%)**	**90/109 (83%)**	**87/109* (80%)**	**91/109 (83%)**	**94/109* (86%)**
PPV	97%	94%	92%	98%	95%	99%

Supplemental Table 2: Detailed performance of PSMA PET/CT and mpMRI in all lesions and clinically significant lesions.

All Lesions	PSMA+/MRI+	PSMA-/MRI-	PSMA+/MRI-	PSMA-/MRI+	Clinically Significant Lesions	PSMA+/MRI+	PSMA-/MRI-	PSMA+/MRI-	PSMA-/MRI+
Index lesions (n=74)	71 (96%)	1 (1%)	1 (1%)	1 (1%)	Index lesions (n=74)	71 (96%)	1 (1%)	1 (1%)	1 (1%)
Secondary lesions (n=32)	18 (56%)	10 (31%)	3 (9%)	1 (3%)	Secondary lesions (n=22)	17 (53%)	3 (9%)	1 (3%)	1 (3%)
Tertiary lesion (n=3)	0 (0%)	3 (100%)	0 (0%)	0 (0%)	Tertiary lesion (n=1)	0 (0%)	1 (100%)	0 (0%)	0 (0%)
Overall (n=109)	**89 (82%)**	**14 (13%)**	**4 (4%)**	**2 (2%)**	Overall (n=97)	**88 (81%)**	**5 (5%)**	**2 (2%)**	**2 (2%)**