

SUPPLEMENTARY MATERIALS

This document provides additional quantitative results and implementation details that support the findings reported in the main manuscript. All supplementary results are reported for transparency and reproducibility.

Supplementary Section S1: Fold-wise Cross-Validation Results

This section reports the fold-wise cross-validation results for all evaluated models. The tables provide per-fold performance metrics corresponding to the aggregated results presented in Tables 2, 3, and 4 in the main text, enabling a more detailed assessment of inter-fold variability and model stability.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.622	0.818	0.720	0.508	0.724	0.616	0.603	0.871	0.737	26.29	13.59	19.73	0.653	0.809	0.733	0.995	0.999	0.997
1	0.626	0.818	0.722	0.513	0.728	0.621	0.602	0.872	0.737	26.01	10.42	19.23	0.630	0.811	0.709	0.996	0.999	0.997
2	0.646	0.759	0.702	0.531	0.668	0.600	0.625	0.803	0.714	27.26	13.62	20.60	0.662	0.771	0.716	0.996	0.999	0.997
3	0.624	0.810	0.717	0.509	0.719	0.614	0.601	0.851	0.726	24.89	15.96	20.30	0.670	0.824	0.750	0.994	0.999	0.996
4	0.584	0.784	0.684	0.477	0.694	0.585	0.561	0.835	0.698	28.26	12.11	20.33	0.627	0.800	0.712	0.994	0.999	0.997

Table 1. Fold-wise cross-validation results of the UNet model.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.639	0.808	0.724	0.525	0.717	0.621	0.627	0.853	0.740	19.83	14.20	16.93	0.635	0.806	0.723	0.997	0.999	0.998
1	0.648	0.810	0.729	0.536	0.721	0.629	0.628	0.859	0.743	22.24	13.09	18.26	0.699	0.808	0.746	0.993	0.999	0.996
2	0.623	0.742	0.683	0.514	0.656	0.585	0.606	0.787	0.696	21.69	12.51	17.23	0.625	0.730	0.677	0.996	0.999	0.998
3	0.635	0.811	0.723	0.524	0.723	0.623	0.619	0.860	0.740	21.13	11.76	16.27	0.644	0.802	0.725	0.996	0.999	0.998
4	0.598	0.791	0.695	0.485	0.703	0.594	0.574	0.863	0.718	25.96	10.31	18.34	0.642	0.785	0.713	0.994	0.999	0.996

Table 2. Fold-wise cross-validation results of the ResUNet (ResNet-34 backbone) model.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.651	0.819	0.735	0.537	0.731	0.634	0.637	0.878	0.757	26.45	11.59	18.78	0.681	0.810	0.748	0.995	0.999	0.997
1	0.618	0.832	0.725	0.513	0.743	0.628	0.597	0.881	0.739	27.10	12.52	20.71	0.651	0.849	0.738	0.995	0.999	0.997
2	0.649	0.771	0.710	0.537	0.672	0.605	0.629	0.808	0.718	28.69	18.43	23.57	0.667	0.800	0.733	0.996	0.999	0.997
3	0.608	0.823	0.715	0.501	0.738	0.620	0.591	0.874	0.732	25.20	11.71	18.25	0.632	0.829	0.734	0.995	0.999	0.997
4	0.574	0.792	0.683	0.466	0.700	0.583	0.550	0.856	0.703	27.07	11.14	19.15	0.602	0.805	0.702	0.995	0.999	0.997

Table 3. Fold-wise cross-validation results of the SegResNet model.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.605	0.810	0.707	0.497	0.717	0.607	0.592	0.858	0.725	21.99	14.16	17.88	0.590	0.797	0.697	0.997	0.999	0.998
1	0.617	0.823	0.720	0.510	0.733	0.621	0.599	0.869	0.734	26.12	12.73	20.26	0.621	0.843	0.718	0.996	0.999	0.997
2	0.631	0.741	0.686	0.522	0.648	0.585	0.612	0.786	0.699	25.00	15.28	20.19	0.633	0.741	0.686	0.996	0.999	0.997
3	0.579	0.812	0.696	0.468	0.725	0.597	0.556	0.858	0.707	24.11	13.04	18.38	0.583	0.826	0.709	0.996	0.999	0.998
4	0.592	0.783	0.687	0.483	0.692	0.588	0.571	0.843	0.707	25.07	12.37	18.84	0.598	0.779	0.687	0.996	0.999	0.998

Table 4. Fold-wise cross-validation results of the SwinUNETR model.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.593	0.798	0.696	0.478	0.703	0.591	0.571	0.847	0.709	27.76	14.96	21.16	0.602	0.803	0.706	0.996	0.999	0.998
1	0.605	0.794	0.699	0.492	0.700	0.596	0.580	0.844	0.712	28.12	10.97	20.68	0.619	0.778	0.689	0.995	0.999	0.997
2	0.624	0.731	0.677	0.507	0.638	0.573	0.598	0.771	0.684	30.54	15.91	23.41	0.640	0.730	0.685	0.995	0.999	0.997
3	0.565	0.801	0.683	0.457	0.710	0.584	0.543	0.842	0.693	31.82	15.27	23.19	0.568	0.829	0.703	0.996	0.999	0.997
4	0.549	0.773	0.661	0.439	0.681	0.560	0.518	0.831	0.675	31.57	13.23	22.66	0.546	0.771	0.657	0.996	0.999	0.997

Table 5. Fold-wise cross-validation results of the Attention U-Net model.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.459	0.763	0.611	0.360	0.660	0.510	0.425	0.811	0.618	34.20	15.93	24.69	0.470	0.756	0.617	0.994	0.999	0.996
1	0.448	0.763	0.606	0.349	0.661	0.505	0.411	0.813	0.612	34.74	16.42	26.71	0.433	0.767	0.579	0.995	0.999	0.997
2	0.484	0.679	0.581	0.378	0.578	0.478	0.444	0.712	0.578	32.40	20.10	26.38	0.486	0.685	0.585	0.994	0.999	0.997
3	0.478	0.785	0.632	0.376	0.690	0.533	0.446	0.831	0.639	34.34	15.89	24.81	0.480	0.778	0.634	0.994	0.999	0.996
4	0.448	0.711	0.580	0.350	0.617	0.484	0.414	0.769	0.592	31.80	12.48	22.14	0.461	0.700	0.579	0.994	0.999	0.996

Table 6. Fold-wise cross-validation results of the TransUNet model.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.634	0.832	0.736	0.535	0.747	0.644	0.630	0.890	0.764	15.28	11.26	13.10	0.644	0.820	0.735	0.997	0.999	0.998
1	0.642	0.828	0.723	0.550	0.745	0.635	0.636	0.883	0.744	16.10	8.00	12.41	0.645	0.819	0.721	0.997	0.999	0.998
2	0.622	0.768	0.695	0.531	0.685	0.607	0.618	0.817	0.716	16.73	9.16	12.91	0.613	0.761	0.686	0.997	0.999	0.998
3	0.623	0.836	0.733	0.526	0.758	0.646	0.619	0.891	0.760	17.24	8.01	12.33	0.617	0.818	0.721	0.997	0.999	0.998
4	0.608	0.799	0.702	0.512	0.715	0.612	0.599	0.864	0.729	19.00	7.02	13.07	0.633	0.785	0.708	0.996	0.999	0.998

Table 7. Fold-wise cross-validation results of the nnU-Net v2 model.

Fold	DSC			IoU			mIoU			HD95			Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean	IS	HS	Mean
0	0.671	0.832	0.752	0.561	0.742	0.651	0.662	0.894	0.778	16.54	9.76	13.83	0.701	0.845	0.775	0.995	0.999	0.997
1	0.659	0.849	0.754	0.570	0.763	0.666	0.659	0.920	0.789	17.63	6.97	13.55	0.666	0.859	0.750	0.996	0.999	0.998
2	0.654	0.799	0.727	0.557	0.706	0.632	0.652	0.860	0.756	19.20	10.68	15.69	0.632	0.792	0.711	0.998	0.999	0.998
3	0.730	0.807	0.768	0.645	0.737	0.691	0.748	0.863	0.806	11.77	5.09	9.61	0.734	0.791	0.764	0.997	0.999	0.998
4	0.627	0.822	0.724	0.540	0.738	0.639	0.630	0.897	0.763	16.36	6.06	12.32	0.605	0.828	0.715	0.998	0.999	0.998

Table 8. Fold-wise cross-validation results of the proposed SDMC-Seg model.

Supplementary Section S2: Test Set Performance Analysis

This supplementary section presents the segmentation performance of all evaluated models on the independent test set. Results are obtained in a fold-aware manner by evaluating the test set for each cross-validation fold and reporting mean $\pm$ standard deviation.

Model	DSC			IoU		
	IS	HS	Mean	IS	HS	Mean
U-Net	0.596 $\pm$ 0.016	0.789 $\pm$ 0.014	0.693 $\pm$ 0.005	0.488 $\pm$ 0.014	0.694 $\pm$ 0.015	0.591 $\pm$ 0.005
ResUNet (R34)	0.627 $\pm$ 0.019	0.795 $\pm$ 0.009	0.711 $\pm$ 0.013	0.516 $\pm$ 0.019	0.703 $\pm$ 0.009	0.610 $\pm$ 0.013
SegResNet	0.601 $\pm$ 0.012	0.809 $\pm$ 0.006	0.705 $\pm$ 0.009	0.491 $\pm$ 0.012	0.714 $\pm$ 0.008	0.603 $\pm$ 0.010
Swin-UNETR	0.582 $\pm$ 0.011	0.783 $\pm$ 0.008	0.682 $\pm$ 0.007	0.472 $\pm$ 0.009	0.689 $\pm$ 0.006	0.581 $\pm$ 0.006
Attention U-Net	0.562 $\pm$ 0.012	0.764 $\pm$ 0.018	0.663 $\pm$ 0.007	0.452 $\pm$ 0.009	0.668 $\pm$ 0.015	0.560 $\pm$ 0.007
TransUNet	0.458 $\pm$ 0.017	0.725 $\pm$ 0.014	0.591 $\pm$ 0.014	0.353 $\pm$ 0.015	0.628 $\pm$ 0.014	0.491 $\pm$ 0.013
nnU-Net v2	0.615 $\pm$ 0.024	0.809 $\pm$ 0.019	0.710 $\pm$ 0.015	0.518 $\pm$ 0.024	0.725 $\pm$ 0.017	0.620 $\pm$ 0.015
SDMC-Seg (Proposed)	0.631 $\pm$ 0.005	0.811 $\pm$ 0.013	0.721 $\pm$ 0.006	0.539 $\pm$ 0.006	0.733 $\pm$ 0.007	0.636 $\pm$ 0.007

Table 9. Test set segmentation performance across models in terms of class-wise and lesion-only mean DSC and IoU scores.

Model	mIoU			HD95 ($\downarrow$)		
	IS	HS	Mean	IS	HS	Mean
U-Net	0.583 $\pm$ 0.015	0.833 $\pm$ 0.019	0.708 $\pm$ 0.005	27.41 $\pm$ 2.18	12.67 $\pm$ 1.61	20.16 $\pm$ 1.17
ResUNet (R34)	0.616 $\pm$ 0.022	0.848 $\pm$ 0.012	0.732 $\pm$ 0.016	23.77 $\pm$ 1.86	12.77 $\pm$ 1.05	18.33 $\pm$ 1.27
SegResNet	0.584 $\pm$ 0.013	0.863 $\pm$ 0.009	0.724 $\pm$ 0.011	28.71 $\pm$ 2.39	10.94 $\pm$ 1.16	19.97 $\pm$ 1.56
Swin-UNETR	0.565 $\pm$ 0.009	0.831 $\pm$ 0.007	0.698 $\pm$ 0.007	26.66 $\pm$ 2.12	13.63 $\pm$ 2.43	20.25 $\pm$ 1.50
Attention U-Net	0.541 $\pm$ 0.012	0.808 $\pm$ 0.018	0.675 $\pm$ 0.007	30.78 $\pm$ 2.78	14.13 $\pm$ 1.98	22.60 $\pm$ 1.85
TransUNet	0.423 $\pm$ 0.016	0.771 $\pm$ 0.016	0.597 $\pm$ 0.014	35.42 $\pm$ 1.48	15.13 $\pm$ 2.07	25.51 $\pm$ 1.61
nnU-Net v2	0.613 $\pm$ 0.027	0.866 $\pm$ 0.021	0.737 $\pm$ 0.017	16.18 $\pm$ 1.33	8.61 $\pm$ 0.59	12.32 $\pm$ 0.57
SDMC-Seg (Proposed)	0.639 $\pm$ 0.016	0.879 $\pm$ 0.017	0.759 $\pm$ 0.005	17.71 $\pm$ 1.99	6.99 $\pm$ 0.89	12.81 $\pm$ 1.21

Table 10. Test set segmentation performance across models in terms of mIoU and HD95.

Model	Sensitivity			Specificity		
	IS	HS	Mean	IS	HS	Mean
U-Net	0.637 $\pm$ 0.034	0.802 $\pm$ 0.018	0.718 $\pm$ 0.021	0.995 $\pm$ 0.001	0.999 $\pm$ 0.000	0.997 $\pm$ 0.000
ResUNet (R34)	0.675 $\pm$ 0.038	0.793 $\pm$ 0.012	0.733 $\pm$ 0.020	0.995 $\pm$ 0.001	0.999 $\pm$ 0.000	0.997 $\pm$ 0.001
SegResNet	0.635 $\pm$ 0.024	0.830 $\pm$ 0.007	0.731 $\pm$ 0.012	0.995 $\pm$ 0.000	0.999 $\pm$ 0.000	0.997 $\pm$ 0.000
Swin-UNETR	0.601 $\pm$ 0.034	0.791 $\pm$ 0.012	0.694 $\pm$ 0.019	0.996 $\pm$ 0.001	0.999 $\pm$ 0.000	0.997 $\pm$ 0.000
Attention U-Net	0.582 $\pm$ 0.028	0.776 $\pm$ 0.035	0.677 $\pm$ 0.017	0.996 $\pm$ 0.001	0.999 $\pm$ 0.000	0.997 $\pm$ 0.000
TransUNet	0.485 $\pm$ 0.037	0.734 $\pm$ 0.014	0.608 $\pm$ 0.021	0.993 $\pm$ 0.001	0.999 $\pm$ 0.000	0.996 $\pm$ 0.001
nnU-Net v2	0.633 $\pm$ 0.031	0.803 $\pm$ 0.016	0.717 $\pm$ 0.018	0.997 $\pm$ 0.000	0.999 $\pm$ 0.000	0.998 $\pm$ 0.000
SDMC-Seg (Proposed)	0.638 $\pm$ 0.035	0.813 $\pm$ 0.019	0.724 $\pm$ 0.018	0.997 $\pm$ 0.001	0.999 $\pm$ 0.000	0.998 $\pm$ 0.001

Table 11. Five-fold cross-validation performance comparison across models in terms of sensitivity and specificity.