

Supplementary Material

Table S1. Per-class accuracy (mean $\pm$ std, %) across different foundation models on the homogeneous split.

Class	Lower Bound	FedFoundAvg	FedFoundAvgM	FedFoundAdam	FedFoundAdagrad	Upper Bound
Colon polyps	59.60 $\pm$ 2.10	74.28 $\pm$ 4.07	60.76 $\pm$ 2.78	56.28 $\pm$ 6.91	65.20 $\pm$ 5.34	83.10 $\pm$ 5.51
Resection margins	28.00 $\pm$ 17.89	64.00 $\pm$ 16.73	36.00 $\pm$ 16.73	32.00 $\pm$ 10.95	36.00 $\pm$ 16.73	32.00 $\pm$ 10.95
Normal stomach	80.62 $\pm$ 1.33	85.26 $\pm$ 1.30	82.76 $\pm$ 1.69	83.22 $\pm$ 1.79	83.20 $\pm$ 3.18	86.14 $\pm$ 3.05
Colorectal cancer	26.64 $\pm$ 3.10	45.16 $\pm$ 10.63	37.00 $\pm$ 4.53	34.04 $\pm$ 6.62	42.92 $\pm$ 5.61	51.14 $\pm$ 14.23
GEJ normal z-line	79.38 $\pm$ 3.15	76.98 $\pm$ 3.46	81.20 $\pm$ 5.00	76.68 $\pm$ 4.23	79.40 $\pm$ 2.27	86.68 $\pm$ 6.53
Cecum	0.00 $\pm$ 0.00	16.52 $\pm$ 10.84	6.94 $\pm$ 4.95	6.06 $\pm$ 4.95	15.62 $\pm$ 8.50	14.78 $\pm$ 7.28
Retroflex rectum	62.86 $\pm$ 7.82	75.72 $\pm$ 10.85	70.00 $\pm$ 5.98	65.70 $\pm$ 9.34	67.12 $\pm$ 6.39	85.72 $\pm$ 8.78
Normal mucosa LB	83.82 $\pm$ 1.68	85.78 $\pm$ 2.56	84.44 $\pm$ 2.20	86.54 $\pm$ 1.73	84.04 $\pm$ 4.62	86.94 $\pm$ 3.38
Duodenal bulb	67.34 $\pm$ 3.71	69.78 $\pm$ 8.53	63.42 $\pm$ 6.68	56.60 $\pm$ 3.99	60.98 $\pm$ 11.04	76.10 $\pm$ 6.98
Normal esophagus	77.86 $\pm$ 8.88	83.54 $\pm$ 3.22	80.00 $\pm$ 1.92	84.28 $\pm$ 8.25	77.14 $\pm$ 10.29	84.26 $\pm$ 1.97
Pylorus	75.76 $\pm$ 3.35	80.74 $\pm$ 5.03	81.98 $\pm$ 2.47	76.74 $\pm$ 2.74	83.74 $\pm$ 4.42	87.76 $\pm$ 3.10
Terminal ileum	79.90 $\pm$ 2.22	84.48 $\pm$ 1.53	83.64 $\pm$ 1.26	80.36 $\pm$ 1.93	82.22 $\pm$ 1.25	84.94 $\pm$ 2.20
Gastric polyps	0.00 $\pm$ 0.00	2.86 $\pm$ 6.40	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	1.42 $\pm$ 3.18	7.14 $\pm$ 7.15
Dyed margins	80.40 $\pm$ 3.29	92.00 $\pm$ 2.00	87.20 $\pm$ 3.03	78.00 $\pm$ 4.47	88.40 $\pm$ 2.61	96.80 $\pm$ 5.22
Accessory tools	94.82 $\pm$ 0.44	94.82 $\pm$ 0.77	94.90 $\pm$ 0.63	92.58 $\pm$ 0.77	92.82 $\pm$ 1.18	96.92 $\pm$ 0.99
Ileocecal valve	51.00 $\pm$ 7.83	64.50 $\pm$ 5.42	49.50 $\pm$ 3.71	62.00 $\pm$ 4.47	60.00 $\pm$ 6.85	73.00 $\pm$ 7.79
Dyed lifted polyps	57.26 $\pm$ 6.74	77.26 $\pm$ 5.22	55.88 $\pm$ 8.59	58.62 $\pm$ 10.61	59.30 $\pm$ 5.12	81.40 $\pm$ 9.94
Esophagitis	9.98 $\pm$ 7.47	37.28 $\pm$ 5.95	20.90 $\pm$ 12.28	25.44 $\pm$ 4.08	30.92 $\pm$ 3.80	29.08 $\pm$ 9.97
Esophageal varices	0.00 $\pm$ 0.00	20.00 $\pm$ 27.39	10.00 $\pm$ 22.36	10.00 $\pm$ 22.36	20.00 $\pm$ 27.39	20.00 $\pm$ 27.39
Blood in lumen	68.22 $\pm$ 4.85	65.32 $\pm$ 11.46	66.48 $\pm$ 7.10	59.42 $\pm$ 5.66	70.02 $\pm$ 16.16	75.28 $\pm$ 8.25
Colon diverticula	16.70 $\pm$ 0.00	23.34 $\pm$ 9.09	16.70 $\pm$ 0.00	13.36 $\pm$ 7.47	20.00 $\pm$ 13.92	26.66 $\pm$ 9.09
Mucosal inflammation LB	29.98 $\pm$ 7.42	39.98 $\pm$ 9.15	36.66 $\pm$ 13.94	29.98 $\pm$ 7.42	26.66 $\pm$ 18.99	26.66 $\pm$ 9.09
Resected polyps	8.44 $\pm$ 4.69	25.26 $\pm$ 9.40	16.86 $\pm$ 11.42	10.54 $\pm$ 5.25	12.66 $\pm$ 7.99	30.54 $\pm$ 7.79
Angiectasia	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
Ulcer	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
Erythema	19.98 $\pm$ 18.24	6.66 $\pm$ 14.89	13.32 $\pm$ 18.24	6.66 $\pm$ 14.89	6.66 $\pm$ 14.89	13.32 $\pm$ 18.24
Barrett's esophagus	22.12 $\pm$ 4.39	36.84 $\pm$ 8.33	43.14 $\pm$ 10.78	32.64 $\pm$ 5.76	44.20 $\pm$ 14.24	46.32 $\pm$ 10.11

Table S2. Per-class accuracy (mean $\pm$ std, %) across different foundation models on the heterogeneous split.

Class	Lower Bound	FedFoundAvg	FedFoundAvgM	FedFoundAdam	FedFoundAdagrad	Upper Bound
Colon polyps	55.28 $\pm$ 2.99	68.32 $\pm$ 5.21	63.50 $\pm$ 3.49	56.40 $\pm$ 5.15	66.20 $\pm$ 3.83	83.10 $\pm$ 5.51
Resection margins	32.00 $\pm$ 17.89	52.00 $\pm$ 10.95	44.00 $\pm$ 16.73	28.00 $\pm$ 10.95	48.00 $\pm$ 10.95	32.00 $\pm$ 10.95
Normal stomach	78.36 $\pm$ 2.10	84.02 $\pm$ 2.41	82.48 $\pm$ 0.86	76.52 $\pm$ 3.40	82.14 $\pm$ 2.86	86.14 $\pm$ 3.05
Colorectal cancer	21.46 $\pm$ 5.49	41.44 $\pm$ 6.62	35.52 $\pm$ 10.66	31.82 $\pm$ 9.65	33.30 $\pm$ 4.53	51.14 $\pm$ 14.23
GEJ normal z-line	80.90 $\pm$ 5.11	83.00 $\pm$ 2.68	81.20 $\pm$ 6.48	73.64 $\pm$ 5.72	82.72 $\pm$ 4.48	86.68 $\pm$ 6.53
Cecum	0.00 $\pm$ 0.00	17.38 $\pm$ 12.70	13.02 $\pm$ 11.09	0.00 $\pm$ 0.00	6.06 $\pm$ 6.57	14.78 $\pm$ 7.28
Retroflex rectum	64.30 $\pm$ 0.00	82.86 $\pm$ 3.89	75.74 $\pm$ 11.96	71.42 $\pm$ 5.06	64.28 $\pm$ 18.23	85.72 $\pm$ 8.78
Normal mucosa LB	84.18 $\pm$ 0.67	86.68 $\pm$ 2.43	83.28 $\pm$ 1.34	82.96 $\pm$ 2.68	82.74 $\pm$ 2.69	86.94 $\pm$ 3.38
Duodenal bulb	56.10 $\pm$ 1.70	67.34 $\pm$ 9.53	67.80 $\pm$ 7.60	59.98 $\pm$ 5.35	68.78 $\pm$ 6.28	76.10 $\pm$ 6.98
Normal esophagus	75.00 $\pm$ 5.63	81.42 $\pm$ 2.96	82.84 $\pm$ 5.30	79.28 $\pm$ 6.39	73.58 $\pm$ 4.07	84.26 $\pm$ 1.97
Pylorus	74.50 $\pm$ 2.26	79.48 $\pm$ 1.91	78.48 $\pm$ 3.38	77.74 $\pm$ 3.22	80.98 $\pm$ 3.83	87.76 $\pm$ 3.10
Terminal ileum	78.26 $\pm$ 2.53	83.54 $\pm$ 3.05	83.40 $\pm$ 1.74	77.88 $\pm$ 1.12	82.26 $\pm$ 1.57	84.94 $\pm$ 2.20
Gastric polyps	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	7.14 $\pm$ 7.15
Dyed margins	83.20 $\pm$ 2.68	88.40 $\pm$ 4.10	85.60 $\pm$ 6.07	86.00 $\pm$ 4.69	86.40 $\pm$ 3.85	96.80 $\pm$ 5.22
Accessory tools	92.90 $\pm$ 0.80	94.10 $\pm$ 1.10	95.06 $\pm$ 1.46	92.02 $\pm$ 1.00	94.02 $\pm$ 0.33	96.92 $\pm$ 0.99
Ileocecal valve	57.50 $\pm$ 5.30	65.50 $\pm$ 5.97	52.00 $\pm$ 4.81	54.00 $\pm$ 11.40	65.50 $\pm$ 4.81	73.00 $\pm$ 7.79
Dyed lifted polyps	55.86 $\pm$ 7.48	66.90 $\pm$ 13.05	58.62 $\pm$ 8.10	55.86 $\pm$ 6.62	67.60 $\pm$ 9.94	81.40 $\pm$ 9.94
Esophagitis	6.34 $\pm$ 5.18	29.10 $\pm$ 10.46	19.10 $\pm$ 13.79	10.88 $\pm$ 6.12	26.38 $\pm$ 4.97	29.08 $\pm$ 9.97
Esophageal varices	0.00 $\pm$ 0.00	30.00 $\pm$ 27.39	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	10.00 $\pm$ 22.36	20.00 $\pm$ 27.39
Blood in lumen	64.10 $\pm$ 3.22	70.00 $\pm$ 7.63	62.34 $\pm$ 5.66	61.16 $\pm$ 7.92	69.42 $\pm$ 7.06	75.28 $\pm$ 8.25
Colon diverticula	16.70 $\pm$ 0.00	26.68 $\pm$ 14.89	29.98 $\pm$ 7.42	0.00 $\pm$ 0.00	16.68 $\pm$ 11.77	26.66 $\pm$ 9.09
Mucosal inflammation LB	23.34 $\pm$ 9.09	40.00 $\pm$ 14.90	39.98 $\pm$ 9.15	26.68 $\pm$ 14.89	43.32 $\pm$ 9.15	26.66 $\pm$ 9.09
Resected polyps	9.48 $\pm$ 4.39	22.12 $\pm$ 9.40	15.78 $\pm$ 7.46	10.52 $\pm$ 3.71	22.14 $\pm$ 5.76	30.54 $\pm$ 7.79
Angiectasia	0.00 $\pm$ 0.00	10.00 $\pm$ 13.69	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
Ulcer	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
Erythema	0.00 $\pm$ 0.00	13.32 $\pm$ 18.24	19.98 $\pm$ 18.24	0.00 $\pm$ 0.00	6.66 $\pm$ 14.89	13.32 $\pm$ 18.24
Barrett's esophagus	17.92 $\pm$ 7.97	46.30 $\pm$ 6.86	33.66 $\pm$ 4.69	22.10 $\pm$ 8.66	50.50 $\pm$ 4.70	46.32 $\pm$ 10.11

Table S3. Per-class detection mAP (mean $\pm$ std) of FedFound models on EDD2020 under homogeneous and heterogeneous splits.

Method	BE	Polyp	HGD	Suspicious	Cancer
Homogeneous Split					
Lower Bound	17.42 $\pm$ 1.87	13.65 $\pm$ 1.39	15.45 $\pm$ 4.27	2.45 $\pm$ 0.93	30.99 $\pm$ 3.59
FedFoundAvg	19.93 $\pm$ 1.54	16.97 $\pm$ 0.46	30.42 $\pm$ 1.12	8.24 $\pm$ 1.36	25.44 $\pm$ 2.71
FedFoundAvgM	17.57 $\pm$ 0.59	14.35 $\pm$ 0.97	23.26 $\pm$ 1.43	7.74 $\pm$ 1.90	22.50 $\pm$ 2.34
FedFoundAdam	17.86 $\pm$ 1.31	16.39 $\pm$ 1.00	17.66 $\pm$ 2.52	5.35 $\pm$ 1.23	22.19 $\pm$ 3.01
FedFoundAdagrad	19.80 $\pm$ 1.53	15.20 $\pm$ 0.86	19.57 $\pm$ 3.11	5.61 $\pm$ 1.54	27.97 $\pm$ 3.44
Heterogeneous Split					
Lower Bound	13.61 $\pm$ 1.35	11.77 $\pm$ 1.32	11.42 $\pm$ 2.37	3.65 $\pm$ 1.16	19.31 $\pm$ 4.96
FedFoundAvg	20.88 $\pm$ 0.44	17.83 $\pm$ 0.51	26.80 $\pm$ 2.37	7.64 $\pm$ 1.94	22.19 $\pm$ 3.21
FedFoundAvgM	13.28 $\pm$ 1.46	11.37 $\pm$ 1.34	10.61 $\pm$ 2.27	2.30 $\pm$ 1.21	17.95 $\pm$ 4.50
FedFoundAdam	15.61 $\pm$ 1.34	13.52 $\pm$ 0.54	15.46 $\pm$ 2.59	4.24 $\pm$ 2.06	23.21 $\pm$ 4.48
FedFoundAdagrad	17.57 $\pm$ 1.04	16.23 $\pm$ 0.59	18.00 $\pm$ 1.24	7.24 $\pm$ 2.50	30.48 $\pm$ 3.90
Upper Bound	23.96 $\pm$ 1.39	20.10 $\pm$ 0.90	35.22 $\pm$ 1.86	7.68 $\pm$ 1.05	20.74 $\pm$ 1.36

Table S4. Per-class segmentation mAP (mean $\pm$ std) of FedFound models on EDD2020 under homogeneous and heterogeneous splits.

Method	BE	Polyp	HGD	Suspicious	Cancer
Homogeneous Split					
Lower Bound	6.23 $\pm$ 0.59	10.44 $\pm$ 0.31	8.34 $\pm$ 2.20	2.32 $\pm$ 1.14	21.71 $\pm$ 2.88
FedFoundAvg	7.47 $\pm$ 0.94	12.96 $\pm$ 0.84	16.83 $\pm$ 2.14	0.42 $\pm$ 0.51	20.83 $\pm$ 2.68
FedFoundAvgM	5.17 $\pm$ 0.14	9.99 $\pm$ 1.33	7.37 $\pm$ 1.46	0.01 $\pm$ 0.02	13.90 $\pm$ 3.09
FedFoundAdam	4.85 $\pm$ 0.41	11.77 $\pm$ 0.82	7.85 $\pm$ 1.36	3.34 $\pm$ 0.67	23.11 $\pm$ 1.64
FedFoundAdagrad	5.21 $\pm$ 0.68	13.51 $\pm$ 0.49	14.40 $\pm$ 1.83	2.10 $\pm$ 1.02	20.71 $\pm$ 3.68
Heterogeneous Split					
Lower Bound	4.70 $\pm$ 0.39	11.21 $\pm$ 0.66	8.93 $\pm$ 0.94	2.38 $\pm$ 1.65	16.02 $\pm$ 0.99
FedFoundAvg	6.27 $\pm$ 0.78	12.02 $\pm$ 0.74	15.33 $\pm$ 0.90	1.37 $\pm$ 0.83	19.47 $\pm$ 0.85
FedFoundAvgM	4.57 $\pm$ 0.35	11.30 $\pm$ 0.79	11.13 $\pm$ 2.20	0.82 $\pm$ 0.49	15.97 $\pm$ 0.68
FedFoundAdam	4.84 $\pm$ 0.30	11.58 $\pm$ 0.40	8.71 $\pm$ 1.78	3.23 $\pm$ 1.26	18.35 $\pm$ 0.66
FedFoundAdagrad	5.19 $\pm$ 0.61	12.73 $\pm$ 0.93	10.59 $\pm$ 2.47	3.37 $\pm$ 0.94	20.51 $\pm$ 1.94
Upper Bound	8.72 $\pm$ 0.71	17.01 $\pm$ 0.55	26.84 $\pm$ 1.94	3.59 $\pm$ 1.77	24.97 $\pm$ 1.86

Table S5. Classification Accuracy (%) and Detection/Segmentation mAP of different methods $\pm$ confidence interval. Significance vs Lower Bound is indicated by * according to the Wilcoxon signed-rank test at $p < 0.05$.

Method	Classification		Object Detection		Segmentation	
	Accuracy (%)	<i>p</i> -value	mAP	<i>p</i> -value	mAP	<i>p</i> -value
Homogeneous Split						
Lower Bound	72.62 $\pm$ 0.47	–	15.99 $\pm$ 1.05	–	9.81 $\pm$ 0.56	–
FedFoundAvg	78.40 $\pm$ 0.48 *	0.03125	20.20 $\pm$ 0.61 *	0.03125	11.70 $\pm$ 0.14 *	0.03125
FedFoundAvgM	74.84 $\pm$ 0.45	0.03125	17.08 $\pm$ 0.29	0.0625	7.29 $\pm$ 0.52	1.00000
FedFoundAdam	73.20 $\pm$ 0.32	0.09375	15.89 $\pm$ 0.72	0.59375	10.18 $\pm$ 0.39	0.15625
FedFoundAdagrad	75.40 $\pm$ 0.90	0.03125	17.63 $\pm$ 0.68	0.03125	11.18 $\pm$ 0.83	0.03125
Upper Bound	81.70 $\pm$ 0.45 *	0.03125	21.54 $\pm$ 0.65 *	0.03125	16.23 $\pm$ 0.43 *	0.03125
Heterogeneous Split						
Lower Bound	71.06 $\pm$ 0.43	–	11.95 $\pm$ 0.99	–	8.65 $\pm$ 0.16	–
FedFoundAvg	77.48 $\pm$ 0.44 *	0.03125	19.07 $\pm$ 0.83 *	0.03125	10.89 $\pm$ 0.38 *	0.03125
FedFoundAvgM	74.88 $\pm$ 0.17	0.03125	11.10 $\pm$ 0.77	0.96875	8.76 $\pm$ 0.40	0.40625
FedFoundAdam	70.86 $\pm$ 0.79	0.78125	14.41 $\pm$ 0.53	0.03125	9.34 $\pm$ 0.40	0.03125
FedFoundAdagrad	75.54 $\pm$ 0.64	0.03125	17.90 $\pm$ 0.43	0.03125	10.48 $\pm$ 0.38	0.03125
Upper Bound	81.70 $\pm$ 0.45 *	0.03125	21.54 $\pm$ 0.65 *	0.03125	16.23 $\pm$ 0.43 *	0.03125

Table S6. Performance metrics across various downstream tasks with different pretraining methods for both homogeneous and heterogeneous splits. All downstream tasks are conducted using frozen features. For classification, MLP classifier-based results are reported. Bold values indicate the highest values for each metric, and underlined values represent the highest values for each split.

Methods	Classification	Object Detection			Instance Segmentation		
	Accuracy	mAP	mAP50	mAP75	mAP	DSC	JC
Homogeneous Split							
Lower Bound	59.95 $\pm$ 0.56	15.63 $\pm$ 1.10	35.86 $\pm$ 3.06	11.94 $\pm$ 1.34	9.06 $\pm$ 0.30	0.645 $\pm$ 0.014	0.639 $\pm$ 0.014
FedFoundAvg	<u>65.15 $\pm$ 0.36</u>	<u>18.91 $\pm$ 0.58</u>	37.88 $\pm$ 2.19	<u>16.36 $\pm$ 1.49</u>	<u>11.28 $\pm$ 0.21</u>	0.660 $\pm$ 0.009	0.654 $\pm$ 0.010
FedFoundAvgM	60.78 $\pm$ 0.50	17.24 $\pm$ 1.31	37.14 $\pm$ 4.29	13.51 $\pm$ 1.30	7.06 $\pm$ 0.79	<u>0.675 $\pm$ 0.013</u>	<u>0.669 $\pm$ 0.012</u>
FedFoundAdam	59.96 $\pm$ 1.02	16.57 $\pm$ 1.32	37.51 $\pm$ 3.28	12.87 $\pm$ 3.03	9.51 $\pm$ 0.63	0.635 $\pm$ 0.029	0.629 $\pm$ 0.029
FedFoundAdagrad	63.37 $\pm$ 0.68	17.66 $\pm$ 0.80	<u>38.40 $\pm$ 2.59</u>	13.11 $\pm$ 0.93	11.08 $\pm$ 0.71	0.660 $\pm$ 0.010	0.655 $\pm$ 0.010
Heterogeneous Split							
Lower Bound	55.06 $\pm$ 0.57	12.31 $\pm$ 0.68	26.72 $\pm$ 2.31	10.30 $\pm$ 0.77	9.02 $\pm$ 0.35	0.602 $\pm$ 0.064	0.596 $\pm$ 0.064
FedFoundAvg	<u>64.88 $\pm$ 0.49</u>	<u>18.99 $\pm$ 1.45</u>	<u>42.73 $\pm$ 4.55</u>	<u>14.68 $\pm$ 1.86</u>	<u>10.89 $\pm$ 0.67</u>	<u>0.657 $\pm$ 0.018</u>	<u>0.652 $\pm$ 0.017</u>
FedFoundAvgM	55.22 $\pm$ 1.044	12.32 $\pm$ 0.37	26.53 $\pm$ 2.14	9.96 $\pm$ 0.74	9.22 $\pm$ 0.77	0.624 $\pm$ 0.007	0.618 $\pm$ 0.007
FedFoundAdam	56.16 $\pm$ 0.48	13.65 $\pm$ 0.63	29.07 $\pm$ 0.72	11.71 $\pm$ 0.85	9.66 $\pm$ 0.26	0.652 $\pm$ 0.015	0.646 $\pm$ 0.015
FedFoundAdagrad	62.81 $\pm$ 0.89	17.07 $\pm$ 0.61	36.48 $\pm$ 1.44	12.75 $\pm$ 1.37	9.97 $\pm$ 0.39	0.647 $\pm$ 0.024	0.640 $\pm$ 0.024
Upper Bound	<u>69.58 $\pm$ 0.38</u>	<u>19.00 $\pm$ 0.67</u>	<u>40.61 $\pm$ 1.35</u>	<u>16.45 $\pm$ 1.79</u>	<u>19.00 $\pm$ 0.67</u>	0.654 $\pm$ 0.011	0.648 $\pm$ 0.011