

Supplementary Tables

Table S1 Distribution of image cores across cancer cohorts and physical TMA arrays.

Cancer type	Physical TMA arrays	No. of arrays	Image cores, n
Breast cancer	Breast_1-1, Breast_1-2, Breast_1-3, Breast_1-4	4	454
Upper Tract Urothelial Carcinoma (UTUC)	UTUC_1M01, UTUC_1M02, UTUC_1M03	3	439
Gastric cancer	Gastric_1M03, Gastric_1M04, Gastric_1M06	3	315
Total	—	10	1,208

Table S2 Classification performance in the additional analyses.

Evaluation scheme†	Accuracy (%)	Precision (%)	Recall (%)	F1-score (%)
Physical-array-held-out analysis‡	82.53	65.70	68.05	66.54
Sample-level soft mean-probability ensemble§	87.80	76.20	80.88	78.18
Sample-level hard plurality-vote ensemble§	86.99	74.53	78.93	76.38
† Precision, recall, and F1-score are macro-averaged across the three target classes (Normal, Cancer, and Others). ‡ The physical-array-held-out values are pooled out-of-fold results across 1,208 image cores. § The sample-level ensemble values are based on the 246-core test subset. The soft ensemble used the unweighted arithmetic mean of the class-probability vectors from ten fold-specific models, whereas the hard ensemble used plurality voting with mean-probability tie-breaking.				