THE PROOF IS IN THE TRAINING

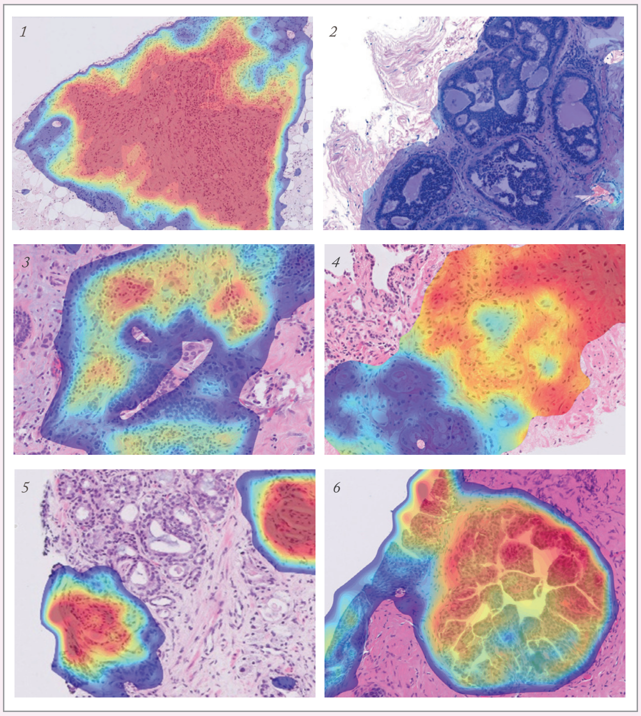
Best practices for training artificial intelligence algorithms for cancer diagnosis

Congratulations! You've just hired a new pathology resident – but, before teaching her how to analyze a tissue biopsy, you may wish to assess which approach will be better:

1. Ask the trainee to diagnose slides, telling her whether a slide is cancerous or benign without explaining what a tumor looks like or its key features, or
2. Jointly analyze slides that include all significant features and morphologies, explaining in detail what nerves and blood vessels look like, how to identify atypical ductal hyperplasia versus ductal carcinoma in situ or invasive ductal carcinoma versus invasive lobular carcinoma in breast biopsies or look for different Gleason grades, high-grade prostatic intraepithelial neoplasia, and perineural invasion in prostate biopsies.

Few would argue that the first approach is optimal – especially given that residents will need to complete full pathology reports and not just identify cancer. Moreover, to accurately detect all cancer types, they also need to be trained on specific – possibly rare – cases that contain structures and cells similar to cancer.

With today's tidal wave of digital pathology, more and more companies and researchers are developing artificial intelligence (AI)-based tools to improve cancer diagnostics. Like any assistant, AI must be trained – but how? Should algorithm developers train it based only on slide-level information from the pathology report (e.g., cancerous or benign)? Or should they dive deep with expert pathologists who rigorously annotate features prior to training and then highlight the model's incorrect predictions?



Results of analysis by strong AI algorithm. Heatmaps of breast biopsy images showing invasive lobular carcinoma (1), low-grade DCIS (2), and tumor infiltrating lymphocytes (3); and prostate biopsy images showing Gleason grading (4), perineural invasion (5), and high-grade PIN (6). All images courtesy of Ibex Medical Analytics.

Again, the first option is tempting – it is less time-consuming, easier to access the necessary data, and requires fewer resources. Unfortunately, it results in "narrow AI" – an algorithm that can handle only one task, such as cancer detection or grading, often with limited accuracy. The second, albeit more meticulous and requiring more effort, results in "strong AI." Strong AI is far more comprehensive and explainable and can support pathologists across a wider range of tasks including finding and grading cancer, identifying subtypes, and detecting other clinical features.

AI offers great promise to pathology and laboratory medicine, improving the quality of cancer diagnostics while enabling more efficient workflows. The secret to developing strong AI that becomes the pathologist's trusted advisor lies in the quality of the training – and, like your next resident, pathologists make the best teachers.

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