Prostate tumor location atlas can contribute to more individualized targeting of biopsy cores

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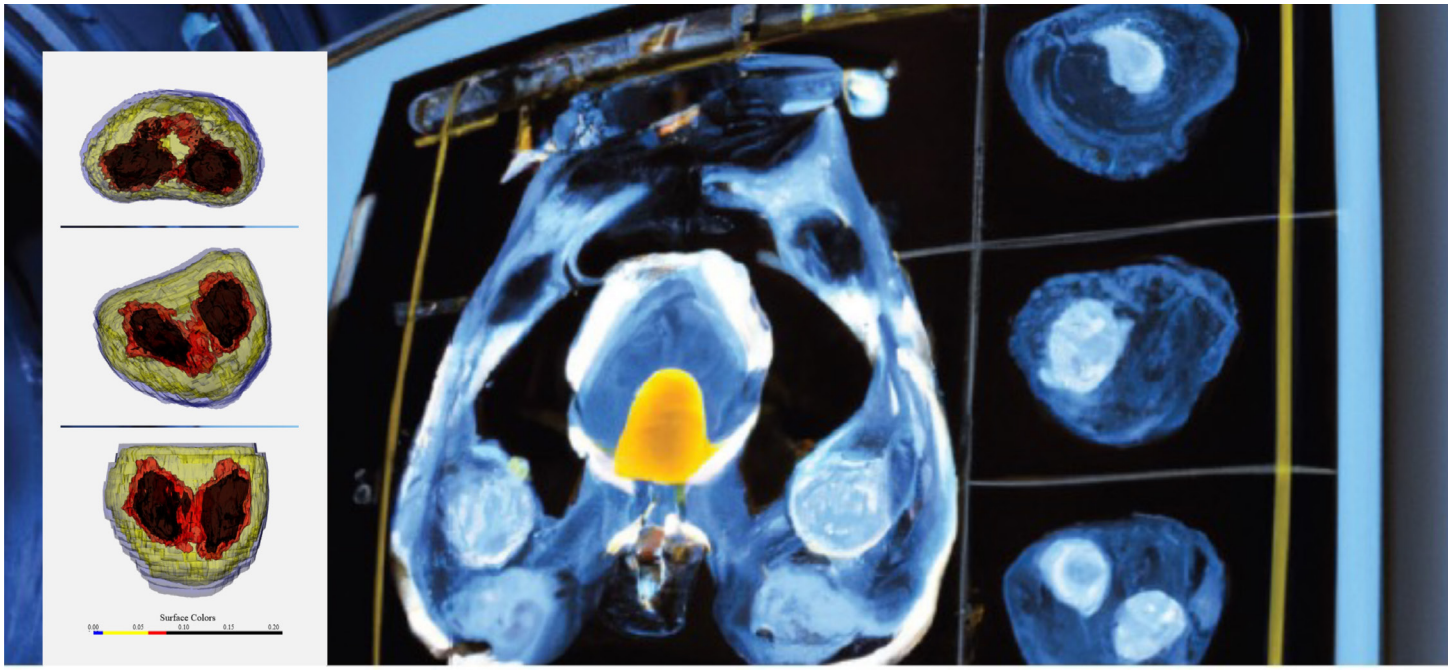
The UCLA Center for Computer Vision and Imaging Biomarkers Lab (CVIB) — with the Integrated Knowledge Database (IKD) — is advancing a personalized medicine approach to prostate cancer imaging that aims to improve targeting of biopsy cores and increase the detection of clinically significant prostate cancer. CVIB has developed a voxel-wise Subpopulation Prostate Atlas (vSPA), and is researching its use as an interactive tool for visualizing the prevalence of prostate cancer lesions. The tool is centered on a probabilistic map that was created in IKD using data from a population with clinically significant prostate cancer, yielding a personalized predictive map for identifying the location of secondary lesions that go undetected on MRI.



A voxel-wise Subpopulation Prostate Atlas (vSPA) showing age < 65, PSA in (4, 10), white, non-Hispanic

Researchers used histopathology findings and clinical and demographic data from over 800 de-identified UCLA patients who had undergone radical prostatectomy to construct a digital atlas showing the prevalence of prostate tumors by location. The clinical and demographic data included age, prostate-specific antigen (PSA) level, race and ethnicity. These variables can be used to interactively query the atlas database to produce customized maps of probabilistic tumor locations that match the individual characteristics of each patient.

The pathology-based atlas is matched to annotated MRI images of each prostate to correlate confirmed cancerous lesions with their corresponding MRI images. Because there are physical differences in the size and shape of the prostates being studied, as well as differences in how the MRI images are acquired, MRI data is registered, or conformed to a virtual "average prostate" for the purposes of the model using artificial intelligence. A mixed effect model was used to evaluate the spatial distributions of voxel-wise lesion prevalence between the atlas and known risk factors of Gleason score and tumor stage. Individualized vSPA was plotted for visualization using the clinical and demographic variables, and the predicted probabilities by Bayesian inference were calculated.

CVIB's research indicated that spatial distribution of subpopulation maps were statistically different by Gleason score and tumor stages ($P<0.05$). Because the subpopulations show different tumor distributions, clinical and demographic data can inform personalized assessment of prostate tumor location and may yield better targeting of biopsy cores. The subpopulation atlas can be updated with new cases over time, which could yield better accuracy of subpopulation atlases and perhaps more granular subdivision of patient populations.