Project abstract

Name of DKFZ research division/group:	***Junior-Clinical cooperation unit "Multiparametric methods for early detection of prostate cancer" (E250)***
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Group homepage: Please visit our website for further information on our research and recent publications.	***https://www.dkfz.de/en/multiparametric-methods-for-early-detection-of-prostate-cancer***

PROJECT PROPOSAL

Multimodal Digital Twin for Solid Tumors Using AI and Real-World Clinical Data

Cancer care relies heavily on unstructured information (doctor's letters, radiology reports) and siloed modalities (imaging, labs, outcomes). As a result, cancer risk stratification is imprecise and evidence from real-world follow-up is underused. This is particularly relevant for first-diagnosed tumors like prostate, kidney and bladder cancer, where the initial therapeutic decision determines downstream therapy, side effects, and outcomes.

Current clinical AI systems commonly analyze imaging in isolation and therefore miss the context-dependent reasoning that expert clinicians apply routinely. Modern multimodal transformer models now enable the joint processing of large image and contextual text information, opening the possibility to approximate context-aware interpretation.

We aim to develop a **clinically meaningful multimodal "digital twin" at the time of first diagnosis**, i.e. a patient-specific computational representation that integrates full clinical text information, medical images, and longitudinal outcomes to support robust risk prediction and clinically actionable decision support in routine workflows. A core pillar is the use of **AI foundation models** (e.g., open models for medical text and image understanding) to accelerate multimodal representation learning and enable scalable clinical translation. A foundation-model-based multimodal representation combined with longitudinal outcomes can enable **better-calibrated risk stratification** and more time-efficient clinical documentation than unimodal or purely structured-data approaches.

This two-year Clinician Scientist project will apply multimodal AI across first-diagnosed urologic tumors (e.g., prostate, kidney, bladder), leveraging a subset of a **tumor documentation cohort of >15.000 first-diagnosed patients**, including clinical letters, imaging,

and long-term oncological follow-up capturing recurrence and subsequent therapies. The project will use state-of-the-art transformer/foundation-model approaches and will fine-tune them on local, real-world documentation language and imaging patterns to ensure relevance and generalizability.

The clinician scientist will be embedded in a **strongly interdisciplinary and supportive environment with close access to clinical workflows and data science expertise**. Mentorship will be anchored by a clinician scientist group leader with excellence in both clinical care and translational research, ensuring clinically meaningful questions, rigorous methodology, and a clear publication roadmap. The fellow will receive structured supervision (clinical and computational) in an enthusiastic team as well as broad opportunities to build an independent profile at the interface of **multimodal AI and outcome-driven oncology**.