

Deep PolyOmics: Towards an Integrative Blood+MRI+Omics AI Model for Early Detection and Diagnosis of Prostate Cancers

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1. Introduction Prostate Cancer (PCa)

- The prostate gland is part of the male reproductive system.
- Prostate cancer is the second most common cancer among males in Western countries [1].
- Estimated ~165,000 new cases and ~29,500 PCA-related deaths in 2018 alone [2].
- PCa is generally a slow growing disease and the majority of men with low grade PCa live for many years without symptoms and without it spreading and becoming life-threatening. However, high grade disease spreads quickly and can be lethal.
- Appropriate management is key.

PCa Diagnosis and Treatment: Current Practice

Prostate screening tests: Prostate-specific antigen (PSA) test from veinal blood sample; Digital Rectal Examination (DRE) to test abnormalities in texture, shape or size of the gland.

Diagnosing PCa: Transrectal ultrasound using a probe; Thin needle biopsy to collect a prostate tissue sample for pathological analysis; MRI fusion combining biopsy and diagnosis; MRI/CT-based diagnosis leading to a PI-RADS score (I-V).

Determining aggressiveness: Pathological examination of biopsied tissue sample to determine how much cancer cells differ from normal cells, leading to a Gleason score (2-10).

Prostate Cancer Risk Factors

- Age:** PCa is an age-dependent disease with risk 1:7 (by age 75) and 1:5 (by age 85).
- Family history:** First-degree male relative with PCa, then higher risk of early PCa.
- Genetics:** Inherited/familial genetic alterations in BRCA1, BRCA2 and HOXB13.
- Genes associated with PCa onset:** ATM, BRCA1, BRCA2, FANCA, HOXB13, PALB2, PTEN.
- Diet and Lifestyle:** Processed meat or food high in fat; Obesity: PCa risk is 9-50% higher per 5-unit of body-mass index (BMI) – likelihood of higher-BMI men diagnosed at advanced stage.

2. Six Metabolic Subtypes of Prostate Cancer Subtypes identified from TCGA (498 Patients)

