



Multi-Omics Liquid Biopsy for Cancer Detection and Treatment-Response Prediction

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Background: Liquid biopsy technologies provide minimally invasive access to tumor-derived molecular information and are increasingly transforming cancer detection, treatment monitoring, and precision oncology. To support translational cancer research and biomarker development, the Hadassah Cancer Research Institute (HCRI) established LiquidBX, a dedicated liquid biopsy biobank integrated within the Hadassah Biobank infrastructure. The platform combines longitudinal biospecimen collection with multi-omics profiling and clinical annotation across diverse malignancies. **Method:** Patients were enrolled following informed consent obtained prior to treatment initiation. Serial collection of plasma, saliva, tissue, and clinical data was performed across multiple cancer types, including non-small cell lung cancer (NSCLC), breast, prostate, bladder, renal, hepatocellular, head and neck, and hematologic malignancies. Samples underwent integrated molecular characterization using cfDNA genomics, epigenomics, transcriptomics, proteomics, and whole-genome sequencing. Multi-modal datasets were analyzed using advanced bioinformatic approaches to identify clinically relevant biomarkers. **Results:** The current cohort comprises more than 800 patients and over 1,400 liquid biopsy samples, generating six complementary omics layers linked to longitudinal clinical outcomes. This resource has enabled several proof-of-concept discoveries. Plasma proteomic profiling successfully distinguished patients with stage I breast cancer from age- and sexmatched healthy blood donors, demonstrating the potential for early cancer detection. In a separate study, cfDNA ChIP-seq analysis identified molecular signatures associated with radiotherapy response in patients with head and neck cancer, highlighting the ability of epigenomic liquid biopsy approaches to support treatment personalization. Beyond these examples, the platform supports investigations of minimal residual disease (MRD), disease progression, patient stratification, and therapy response monitoring across multiple cancer types. **Conclusion:** LiquidBX illustrates the value of an institution-wide liquid biopsy biobank as a foundation for precision oncology research. By integrating longitudinal sampling, rich clinical annotation, multi-omics technologies, and computational analytics, the platform accelerates biomarker discovery and validation while enabling translation of molecular insights into clinically actionable tools for cancer management.