

# Capturing Ethnic Diversity of Cancer: Ultra-Rapid BioBanking at Boston Medical Center for Next-Generation 4D Pathology

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## ABSTRACT

Highest-quality BioBanking of human specimens is of utmost importance for life science research and the future of personalized medicine. We show that the pathologist is central to the successful establishment of high-content, high-quality, deeply annotated biospecimen collection, preservation, and analysis. Active intraoperative pathology consultation and infrastructure for *ultra-rapid specimen procurement* (<10 min) are shown to be key elements of success.

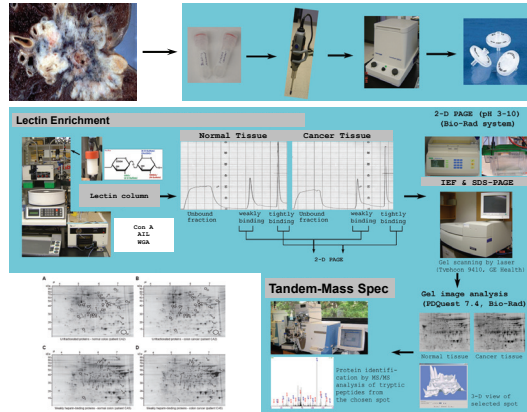
Current collection efforts have largely ignored the need for systematic ethnically diverse representation of both diseased and normal tissues for cancer research. Boston Medical Center serves a large, ethnically extremely diverse patient population that includes a significant number of traditionally underserved minority populations. Boston Medical Center has launched a major effort to *comprehensively capture biospecimens across all ethnicities* with a special emphasis on representation from minority populations (currently ~50% of all collected specimens), including African Americans, Asian Americans, Hispanics, and recent immigrants from literally around the world.

We use several of our ongoing tissue-based *proteomic cancer biomarker research* projects on human colorectal and lung adenocarcinomas to illustrate the critical steps necessary to make BioBanking a success. We will also present very recent work on *colon cancer metabolomics* using ultra-fresh tissue procurement and high-field <sup>1</sup>H NMR spectroscopy.

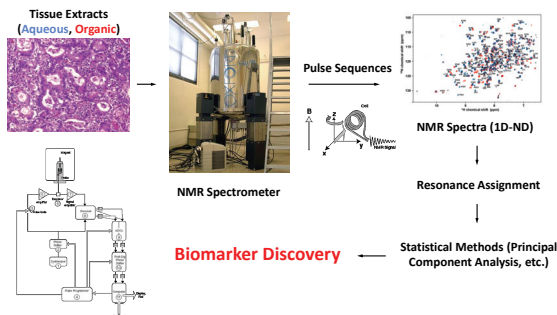
It is critical that today's samples are collected with the prospect of faithfully *preserving the entirety of the captured physiome* to prepare for future studies using methods that may not even be envisioned at the time of collection (future-proofing). As one example, we have begun to use specifically adapted BioBanking workflows to include primary disease tissue cultures as a springboard to overcome the time-static snapshot paradigm of current diagnostic medicine. We are working towards predictive functional ex vivo interrogation of patient tumor tissue to guide targeted molecular therapies (such as EGFR inhibition in lung cancers) based on *individualized tumor drug sensitivities* and tumor response heterogeneity. We have termed this time-domain advance into personalized dynamic disease management *4D Pathology*.

Our own specific scientific examples highlight the central role of the academic pathologist as the key physician-scientist that will make high-quality BioBanking an invaluable resource for the next generation of molecular diagnostics and disease-centered research.

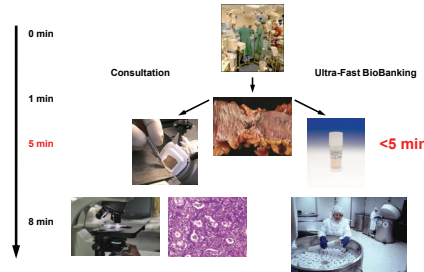
## Principles of Cancer Tissue Proteomics



## Principles of NMR-Based Tissue Metabolomics



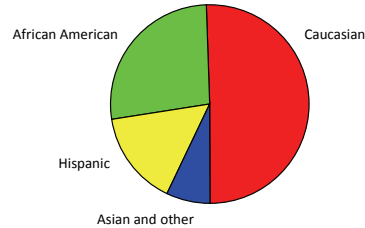
## Intraoperative Pathology Consultation: The Gateway To BioBanking



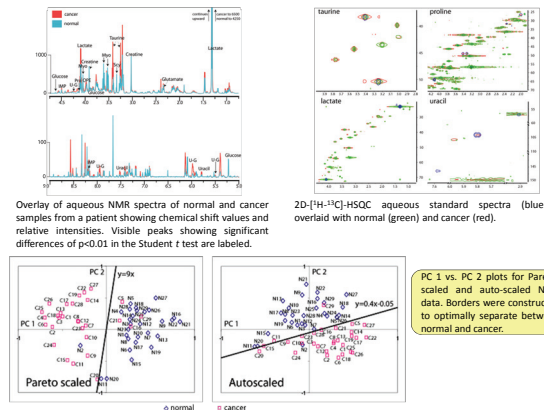
### Moving Transformative Pathology Forward Intraoperative Consultation in Pathology

- Intraoperative Pathology ("Frozen Section Pathology") provides high-value, real-time diagnostic decision making information during surgery or other interventional procedures (e.g., image-guided biopsies) and is a *springboard for moving the future of pathology forward*
- Essential for BioBanking (speed of sample procurement, quality of material, achieving highest banking rates)
- Critical for the future of molecular diagnostic medicine (functional assay development, triaging, real-time assay development – genomic/transcriptomic/proteomic etc., therapy response prediction and monitoring)
- Critical for patient care (real time feedback)
- Critical for real-time personalized therapeutic/diagnostic decision making within the health care team (pathologists, surgeons, medical oncologists, radiation oncologists)

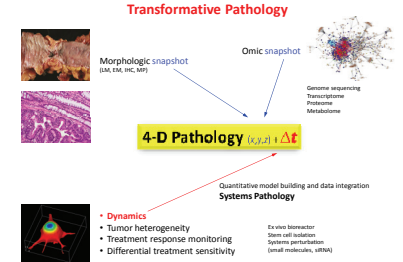
## Ethnic Diversity of BioBanking at Boston Medical Center



## Tissue-Based Metabolomics of Colon Cancer

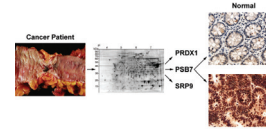


## 4D Pathology – Personalized Dynamic Disease Management

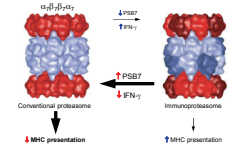


## Scientific Examples – High-Quality BioSpecimens

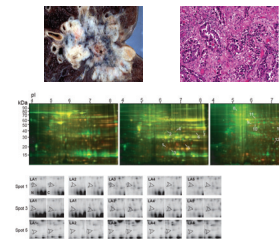
### Proteomic Alterations in Colon Cancer



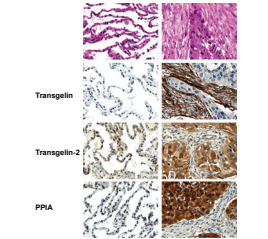
### Functional Significance of PSBT: MHC Class I Escape?



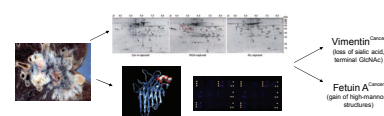
### Proteomic Alterations in Lung Cancer



### Proteomic Alterations in Lung Cancer



### Differential Expression of Glycoproteins in Lung Cancer



### Tissue Glycoarray Analysis



- New candidate biomarkers of pulmonary adenocarcinoma
- Discovery of altered protein glycomics in cancer
- Glycoarrays and tandem mass spectrometry are powerful proteomic tools
- Complexity of the glycoproteome in the pathophysiology of human cancer

PC 1 vs. PC 2 plots for Pareto-scaled and auto-scaled NMR data. Borders were constructed to optimally separate between normal and cancer.