Novel Prediction of Five-Year Survival and Recurrence Rates and Discovery of Cancer Genetic Biomarkers Using MIBI Scans in the Tumor-Immune Microenvironment

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Colorectal cancer (CRC) is responsible for 864,989 deaths annually, making it the second leading cause of cancer death worldwide. The leading upstream cause of cancer deaths is a lack of clinically approved biomarkers, causing inaccurate five-year survival and recurrence predictions for patient risk stratification and treatment management. Thus, my project presents a low-cost, noninvasive computational platform to predict the survival and recurrence rates of cancer patients one year in advance using newly identified biomarkers in the tumor-immune microenvironment (TIME). The first step is to preprocess the ~76k multiplexed ion beam imaging (MIBI) scans of TIME and train a 54-layer MobileNetV2 model to recognize cancerous tissue, profile cell-to-cell interactions and protein patterns, and establish links between the spatial organization of cells with varying expression patterns. By translating this information, the model generates a dataset of transformed biomarkers, which is leveraged to train the Cox Proportional Hazards Model. The neural network simultaneously evaluates the effect of prognostic factors on survival and predicts a rate for each patient. The identification and diagnosis models achieved AUROCs of 0.93 and 0.98 respectively, successfully exceeding all incumbent clinical techniques. This technique can be generalized to other cancer types and diseases and will lead to better clinical outcomes and spare patients from unnecessary aggressive therapies. Ultimately, this platform helps solve one of precision medicine’s primary limitations and is a pragmatic tool with industrial viability that offers clinicians the ability to leverage its personalized predictions to amplify diagnostic accuracy, determine robust treatments earlier, and save millions of lives.

Awards Won:

Fourth Award of $500