The Development of a Low-Cost Holistic System for the Stratified Screening of Pancreatic Ductal Adenocarcinoma Utilizing Urinary miRNA Biomarkers

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Pancreatic ductal adenocarcinoma (PDAC) is a belligerent, often lethal, form of cancer, with a 5-year survival rate limited to 7%. PDAC is hardly detected in its premalignant stages (when surgery is viable), due to modern screening methods being both expensive and inconvenient. This project utilizes a panel of miRNA Urinary Biomarkers: LYVE1, TFF1, and REG1B, combined with age, gender, and creatinine for a diagnostic test to screen for PDAC. This panel of biomarkers can be an indicator of increased desmoplasia within pancreatic acinar cells. With a Random Forest machine learning algorithm, PDAC can be detected with 86% accuracy, equally as precise as the gold standard, an endoscopic ultrasound. In addition to the machine learning algorithm, a low-cost qPCR solution was also developed to amplify and quantify the biomarker levels from patient samples. The device uses an Arduino-controlled negative feedback circuit for the thermocycling of the miRNA. Then, level extraction is done with CMOS Camera and fluorescence detection algorithm. A web-based application shows live feedback on the PCR cycle times, emitted fluorescence (with Quantifish), and camera monitor of the device. Once the levels are extracted with the device, they can be inputted into the Random Forest algorithm for a PDAC Screen. This solution can be implemented into annual clinics as a standard of care, as urine tests are non-invasive, cheap, and fast. With more research, it holds the potential to revolutionize PDAC detection, treatment, and patient prognosis.

Awards Won:
Third Award of $1,000