Biomarkers harness the potential to improve the standard care of the current medical practices. Conventional methods for biomarker discovery rely on analytical techniques to identify biomarkers based on clinical or experimental observations, and once identified, validation and assay development follows. Unfortunately, discovery to translation of biomarkers for clinical practices require labor intensive, time consuming, and expensive procedures; thus, this process remains an enormous challenge. Due to this pitfall, not many reliable biomarkers have been identified and implemented for clinical practices. Therefore, new approaches are in urgent need to improve the effectiveness of biomarker discovery and translation. In this proposal, I aim to tackle this obstacle by utilizing *in vitro* selection technique with patient urine samples to evolve and isolate molecular binders that will recognize a panel of biomarkers capable of distinguishing cancerous from non-cancerous urine. Recent research has demonstrated that *in vitro* selection technique has the capabilities to generate molecular binders highly specific to a microorganism from a complex mixture sample without prior target separation and identification steps. Therefore, I hypothesize this method is also feasible for diseases. Applying *in vitro* selection technique with functional DNA aptamers encoded with signal generating capabilities forms a synergetic combination suited for the concurrency of biomarker discovery and assay development. Achieving this will be extraordinary and paradigm shifting for the future of medicine.