Edge- Intelligence Biosensor Based Point-of-Care Diagnostic Device for Chronic Kidney Disease

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Chronic kidney disease (CKD) is a devastating illness. It has reached epidemic proportions worldwide, and continues to increase at an alarming rate. Kidney disease is the ninth leading cause of death in the United States, and disproportionately affects minority populations. About 37 million people suffer from CKD, with more than 726,000 suffering from end-stage renal disease. Medicare spends about $114 billion each year on treating kidney disease. The objective of this study is to develop an intelligent point-of-care diagnostic device for early detection and ongoing monitoring of CKD using a disposable low-cost non-invasive urine albumin-creatinine ratio (ACR) biosensor. Cyclic voltammetry was used to measure peak redox current to detect the concentration of creatinine and albumin in urine, using an electro-chemical biosensor. The peak current for varying levels of concentration of urine creatinine and albumin was determined through three trials for each concentration. ANOVA and Regression analysis confirmed a significant linear relationship between creatinine and albumin concentrations, and the corresponding peak redox current. This relationship is the basis on which the peak redox current of an unknown sample is used to determine sample creatinine and albumin concentrations, and thereby calculate the ACR of the unknown sample. The electro-chemical biosensor was then used together with edge-computing to develop an intelligent diagnostic device based on ACR measurement. This study successfully developed a prototype of an edge-intelligence low-cost device, as a point-of-care non-invasive solution for testing ACR to detect and monitor CKD, thereby improving early detection and patient care.

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