

NEPHRO: Novel Evaluative Probe for Hydration Real-Time Observation

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Chronic kidney disease (CKD) affects more than 20 million Americans and is commonly treated with hemodialysis (HD), a treatment that replaces kidney function by removing excess fluid from the body. There is a need for a method to assess fluid volume in HD patients to ensure that fluid overload or depletion does not occur. Our goal is to demonstrate the feasibility of NEPHRO, a novel wearable short-wave infrared (SWIR) probe with an integrated pressure sensor, to quantify water and lipid composition in tissue in a non-invasive, direct, and computable way. Developments in SWIR technology enable a quantitative and non-intrusive way to image tissue with higher transparency and resolution than near-infrared spectroscopy (NIRs) imaging. The probe has LEDs of 980, 1200, and 1300 nm and source-detector separations (SDSs) of 7, 10, 13, and 16 mm. Light from the LEDs penetrate tissue and the photodiode measures the absorbance of the reflected light, which is then converted to an electrical current with a measurable voltage. The microcontroller connected to the photodiode stores the voltage measurements taken. We are investigating the relationship between the voltage signal and the concentration of water and lipid in a sample using tissue-mimicking phantoms and in vitro trials to determine the amount of excess fluid carried by a patient. Our integrated pressure sensor has allowed us to ensure that NEPHRO is making sufficient contact with the tissue. We hope that our device will be able to provide a personalized and precise measurement to improve patient care for HD patients.

