The Reusable Handheld Electrolyte and Lab Technology for Humans (rHEALTH) Sensor

Biomedical analysis sensor shrinks hospital lab to single point-of-care (POC) device

The DNA Medicine Institute has produced a reusable microfluidic device that performs rapid, low-cost cell counts and measurements of electrolytes, proteins, and other biomarkers. The rHEALTH sensor is compact and portable, and it employs cutting-edge fluorescence detection optics, innovative microfluidics, and nanostrip reagents to perform a suite of hematology, chemistry, and biomarker assays from a single drop of blood.

A handful of current portable POC devices provide generalized blood analysis, but they perform only a few tests at a time. These devices also rely on disposable components and depend on diverse detection technologies to complete routine tests—all ill-suited for space travelers on extended missions. In contrast, the rHEALTH sensor integrates sample introduction, processing, and detection with a compact, resource-conscious, and efficient design.

Developed to monitor astronaut health on the International Space Station and during long-term space flight, this microscale lab analysis tool also has terrestrial applications that include POC diagnostics conducted at a patient's bedside, in a doctor's office, and in a hospital.

Applications

NASA

- Real-time health monitoring and intervention
- Collecting electrolyte and complete blood count (CBC) measurements
- Measuring cardiac biomarkers for chest pain to test for myocardial infarction
- Monitoring astronaut renal function to assess kidney volume status
- Tracking bone biomarkers and calcium levels to assess bone loss and remodeling

Commercial

- Real-time health monitoring and intervention
- Measuring daily hematocrit for patients on anticoagulation therapy
- Detecting acute myocardial damage
- Tracking white blood cell counts throughout prolonged antibiotic courses
- Monitoring daily renal function of patients with kidney transplants or those with end-stage renal disease
- Measuring body fluid status of elite athletes to guard against dehydration
- Daily monitoring of electrolyte status for individuals taking diuretics

Phase II Objectives

- Complete prototype concept design and review
- Finalize subassembly optics testing, fluidics handling, electrical components, and software
- Establish micron chip prototyping, silica chip capabilities, and fingerstick blood collection device
- Determine accurate and repeatable CBC with differential for physiological samples
- Conduct blood electrolyte experiments to test system accuracy and precision
- Develop ratiometric mixing capabilities for the spiral vortexer
- Conduct reagent shelf-life tests
- Develop nanoliter reagent and flushing protocols for chip reuse

Benefits

- Allows rapid, low-cost analysis of a wide range of samples
- Reduces mass and volume of POC diagnostic technology
- Does not rely on single-use disposable components

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