InnovaStrip: Fast, Comprehensive, Small-Volume Blood Diagnostics via an Algorithm for Handheld Analysis of Rapidly Solidified Drops into Thin Films

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More than 4 billion blood tests are performed annually worldwide. State-of-the-art diagnostics requires 7-10 mLs of blood and takes hours to days for results. Drawing mLs of blood for multiple tests leads to Hospital-Acquired Anemia (HAA) at a 74% rate in hospitalized patients. Anemia is associated with severe COVID-19 cases, so HAA is especially harmful in the COVID-19 pandemic for patients near COVID-19 patients. This work created a new small biomedical device InnovaStrip, which applies materials science to create blood collection wells coated with hyper-hydrophilic coatings, HemaDrop. HemaDrop rapidly solidifies micro-liters of blood into Homogeneous Thin Solid Films (HTSFs), for rapid and accurate testing. Rutherford Backscattering Spectroscopy (RBS) and X-Ray Fluorescence (XRF) analysis reproducibly analyze HTSF. However, RBS involves large equipment while the XRF simulation software for handheld XRF yields 20-100% error on trace elements. To develop InnovaStrip into accurate, fast, comprehensive, handheld diagnostics for common blood tests - electrolytes, heavy metals, and iron - a new, accurate, analysis algorithm (FABA) and mobile app (FHAX) were created. FABA allows results from XRF spectra data in mg/dL (the conventional medical unit) for blood elements/components such as Na, K, Mg, Ca, Heavy Metals like Hg and Pb. FABA is integrated into a mobile app FHAX, which yields results within seconds in mg/dL via inexpensive HTSF calibration solutions, built-in the InnovaStrip device with an accuracy <10% error. Handheld XRF and the FHAX app allow point-of-care blood diagnostics in unserved/remote areas in <20 min with reduced blood volume by a factor x1000.

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