

Algorithm for Fast, Accurate Blood Analysis by X-Ray Fluorescence on Homogeneous Thin Solid Films of Microliter-sized Whole Blood Droplets

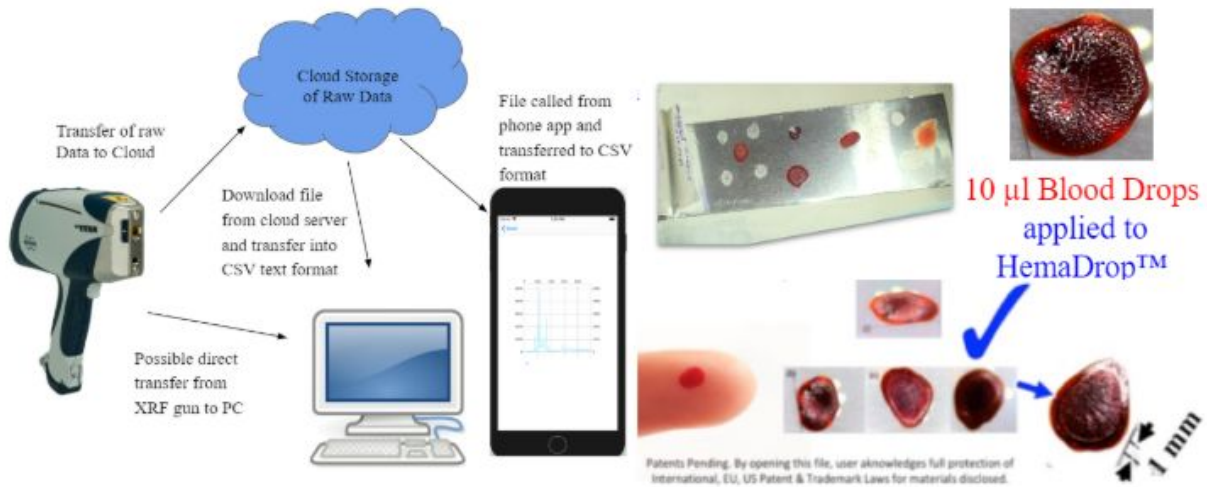


Figure 1: a) Data pathway summary showing the blood analysis process can be expedited by computing the analysis algorithm, can be applied in many places b) HemaDrop™ coatings transforming liquid µL-sized drops into planar, smooth, uniform Homogenous Thin Solid Films (HTSFs) 1,2. These HTSF can be analyzed in air or in vacuo via XRF, Ion Beam Analysis, and any solid state analytical UHV spectroscopy, such as XPS.

How predecessors tried to reduce blood volume but failed:

Reducing the volume extracted for blood tests in infants or the chronically ill reduces anemia, pain, and other issues. In 2016, Theranos claimed to use nL-sized samples for blood diagnostics but failed to meet lab standards with relative errors > 10%, sometimes > 300%. It hid these inaccuracies from the FDA and physicians and resorted to secret, risky blood dilution to generate volumes in the mL range and used HPLC standards. It has been banned from the blood testing market by the FDA for three years.

DESIGN FOR Collection Substrate

- HemaDrop™ Collection Substrate:
 - slide cladded with Al with
 - 4 solidified HTSF from calibration solution
 - **3 blood drop collection wells**
- Reliability & accuracy via built-in use of 3 drops
- Accuracy through multiple calibration HTSF

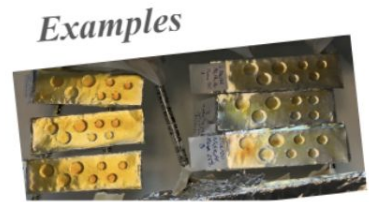
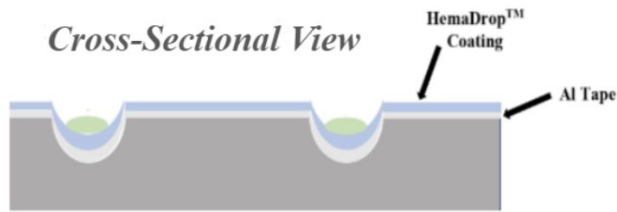
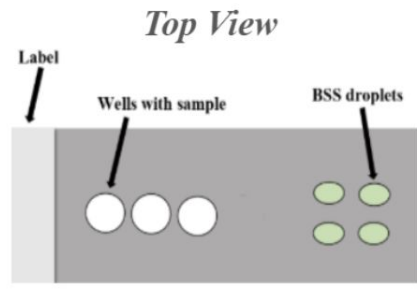


Figure 2: Collection substrate samples and design including patent-pending design figures¹ as well as examples of actual samples produces in a Biosafety Level 2 Laboratory

Specifics on calibration solution:

A calibration fluid such as Balanced Saline Solution (BSS+) is shown to solidify easily into uniform, planar, HTSF, instead of crystal precipitates. The BSS HTSF is analyzed with the blood HTSF in a compact, portable XRF¹ unit with handheld ones.

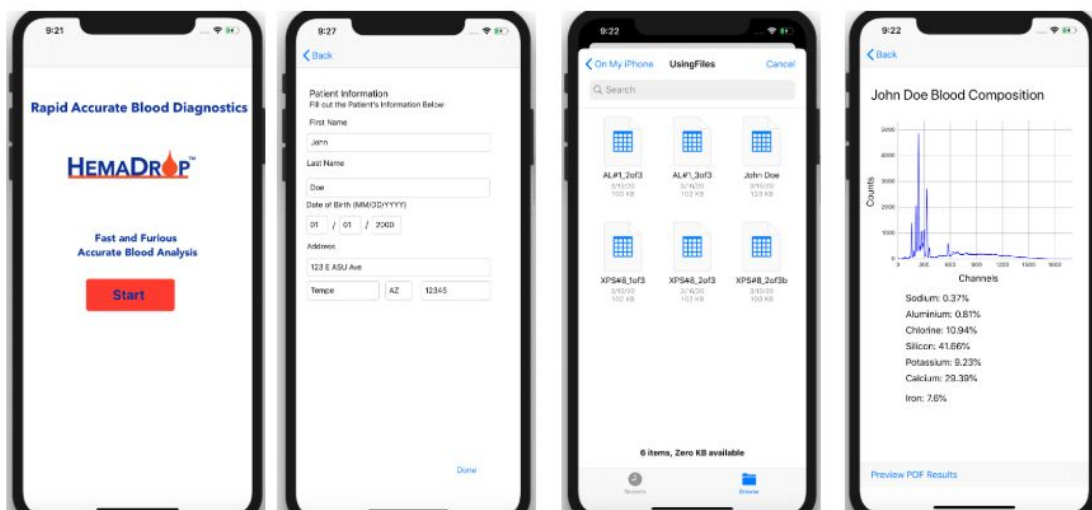


Figure 3: Screenshots of the prototyped FHAX app for iPhone. The screenshots show the welcome screen, patient data input screen, data file selection for the specified patient, and the results screen (left to right). The following is a youtube link to a video demonstration of the app: https://youtu.be/F5Y-_Djk6hQ

How our research saves time:

Since blood tests target specific components, e.g. Na, S, K, Mg, Cl, Cu, As, Zn, and Fe, specific elements can be selected for a specific diagnostic and measured more accurately with about an order of magnitude more speed, e.g. 1-2 min at most for 10-15 blood electrolytes and metals instead of 15-20 min for 117 elements.

¹N. Herbots, N. Suresh, *et al*, US & Intl. Pat. Pend. (2016-18 020), Assign. ASU ABOR, SiO2 Innovates, MicroDrop Diagnostics.