

**Human Research Program
Exploration Medical Capability (ExMC)**

rHEALTH Laboratory Analyzer ISS Increment 66 Tech Demo

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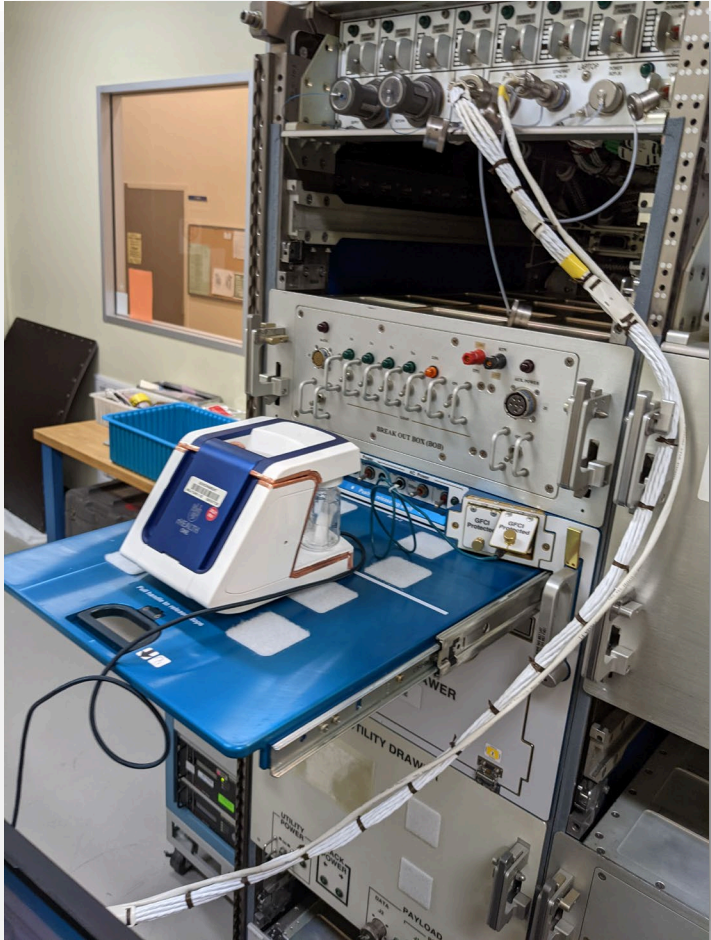
Expanding the Boundaries of Space Medicine and Technology

Reusable Handheld Electrolyte and Lab Technology for Humans (rHEALTH)

Topics -

- **Science background and hypothesis**
- **Investigation goals and objectives**
- **Measurement approach**
- **Importance and reason for ISS**
- **Expected results and how they will advance the field**
- **Earth benefits/spin-off applications**

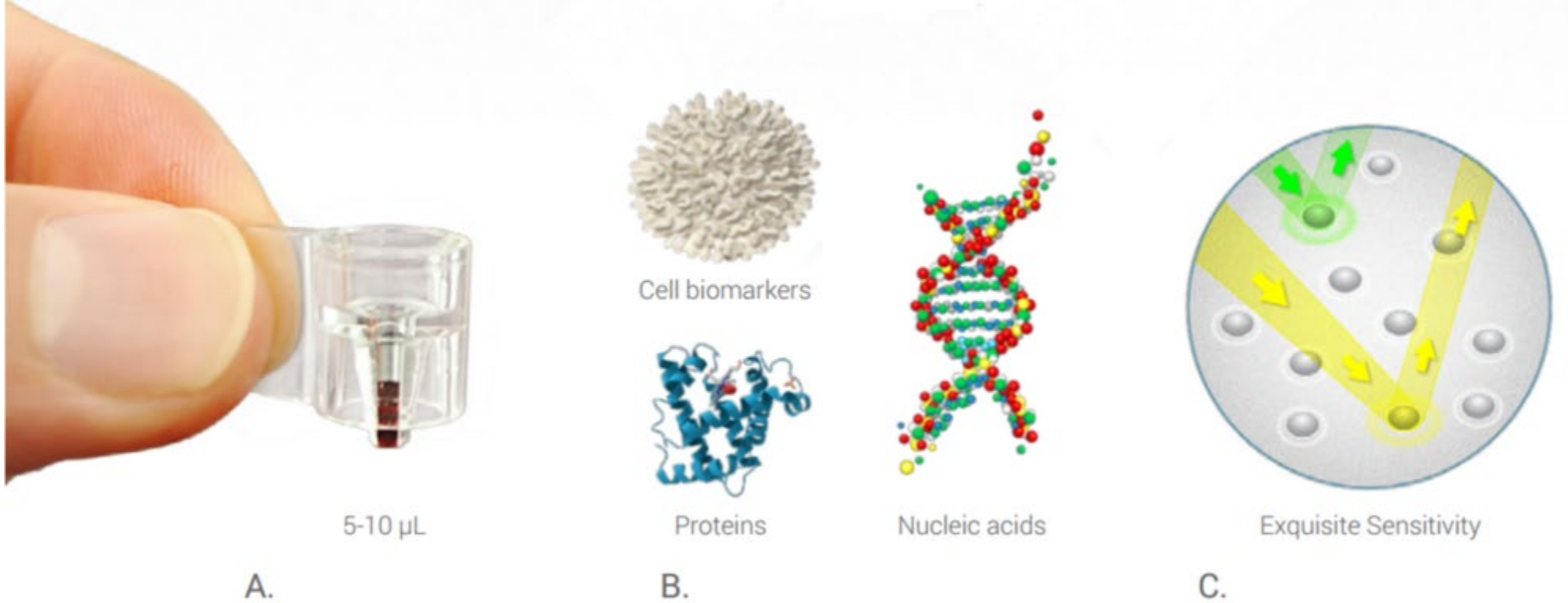


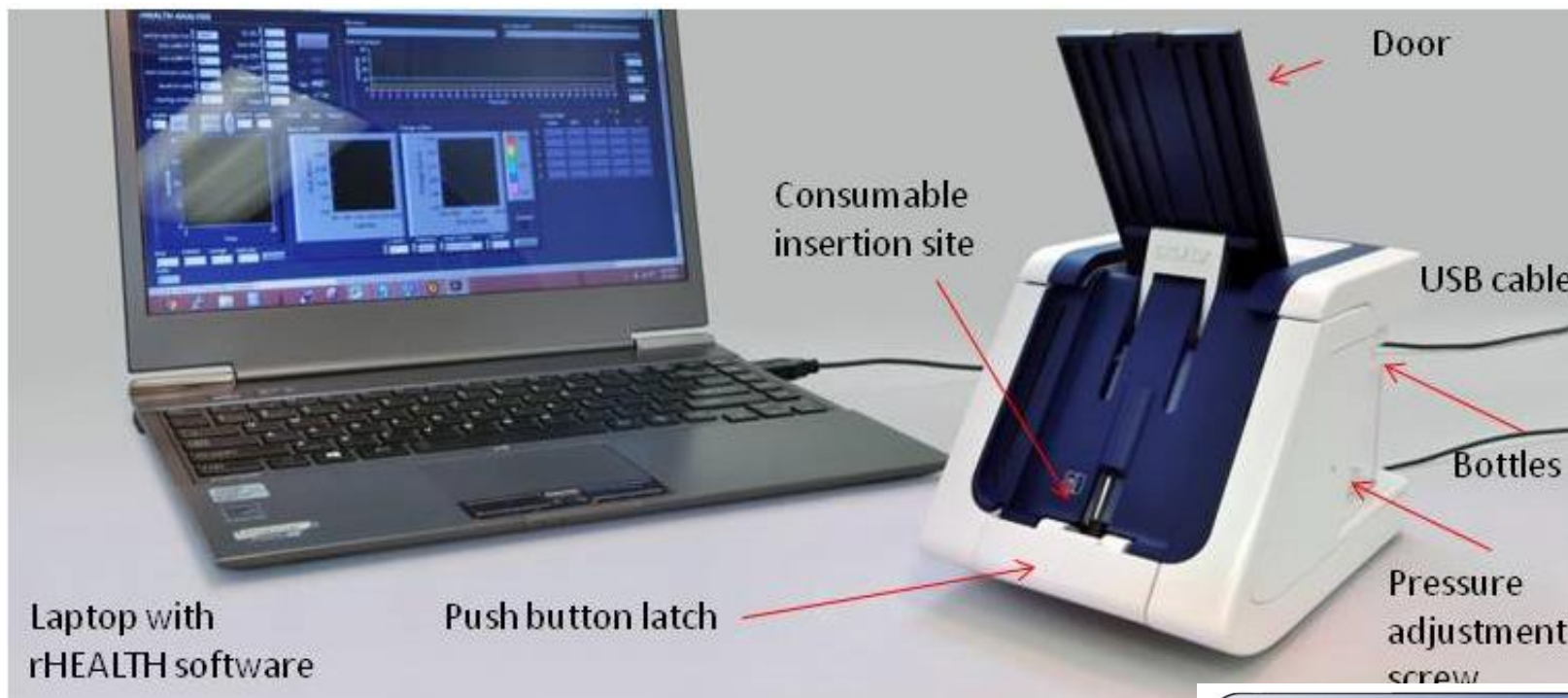


*rHEALTH ON® HRF Rack Integrated
Software Testing at NASA JSC*

rHEALTH ISS Tech Demo

- Purpose: Determine the ability of the underlying mechanisms used by the rHEALTH ONE laboratory analyzer to complete **flow cytometry** in microgravity. “rHEALTH” is the approved OpNom for this payload.
- Successful demonstration of the capability would be a positive step toward future in-flight use of the rHEALTH Awesome® analyzer, which could be used for a **broad range of laboratory analyses** (for both medical and research purposes) including cell counts, hemoglobin, immunoassays, nucleic acids, small molecules, and chemistry.





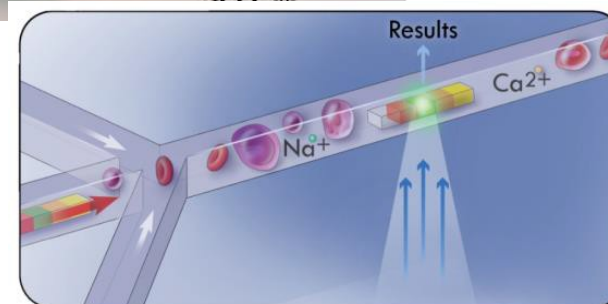
Manual sample preparation

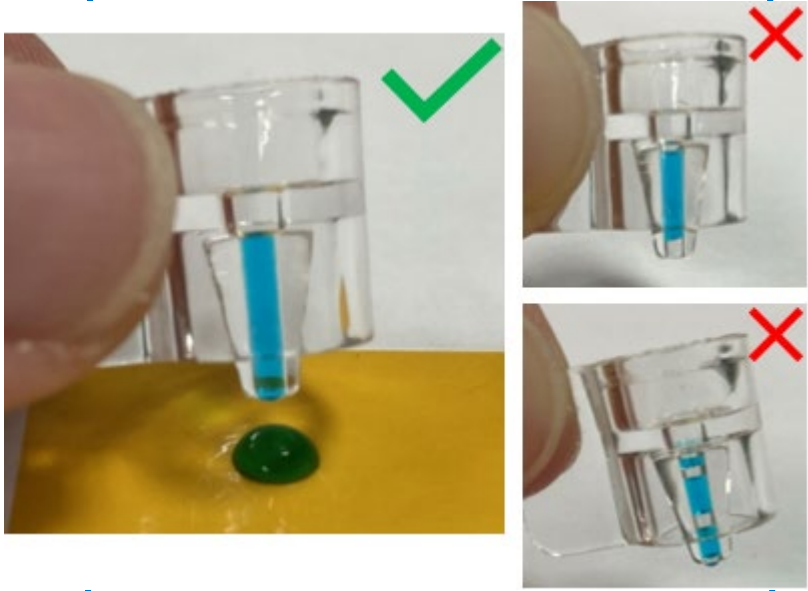


Micro volume analysis of cells, nanostrips, lumibeads

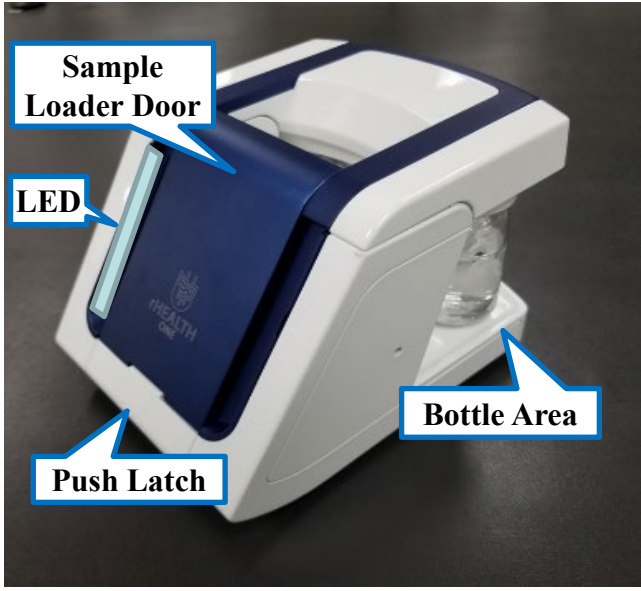


PC-based user-based data analysis

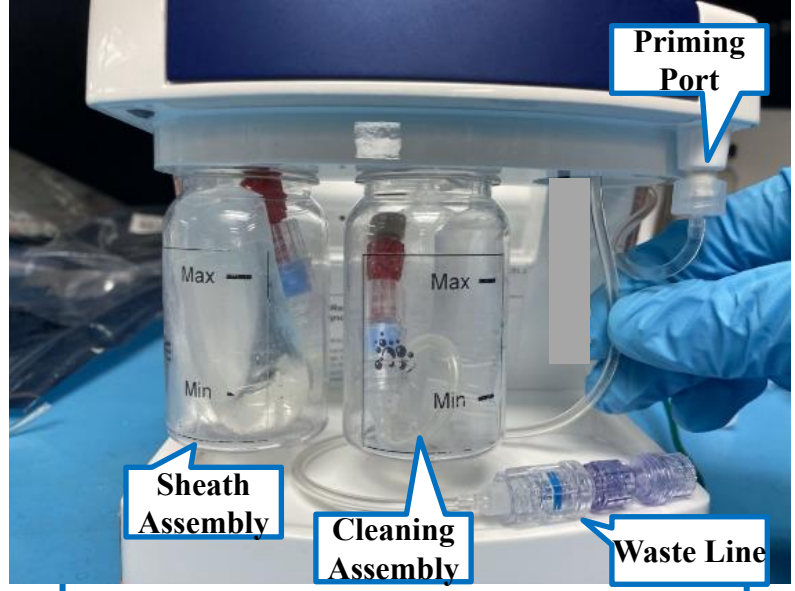




Sample cup filling – showing good and bad fills

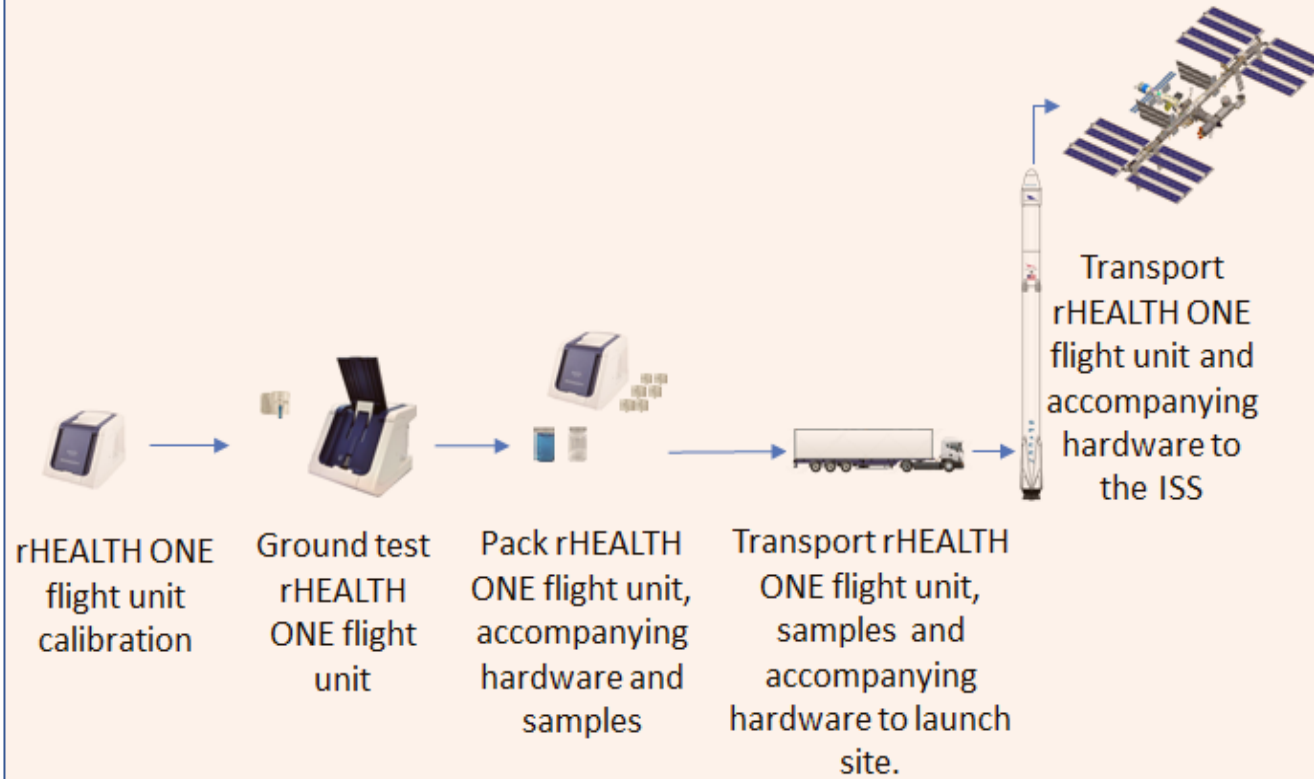


rHEALTH ONE Analyzer - Front

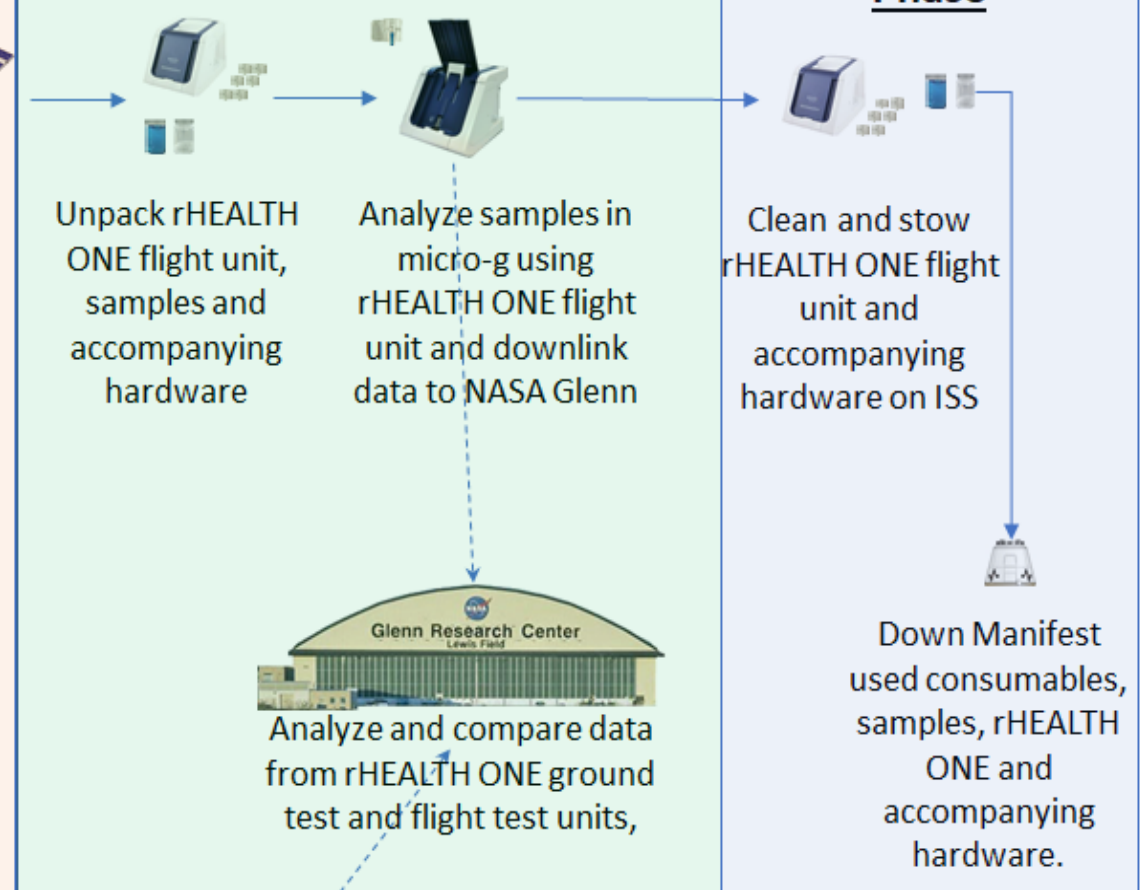


rHEALTH ONE Analyzer – Rear, showing bottle modifications

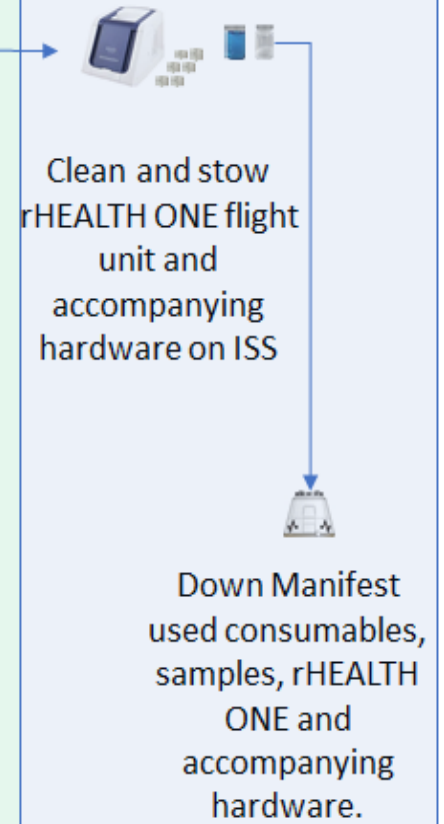
Pre-Launch Phase



Orbital Demonstration Phase



Post Demonstration Phase



- rHEALTH ops require 3 sets of trials for each of 4 Control Solutions
 - Crewtime assumed activity split over 2 separate sessions
- Session Flow:
 - Procedure review
 - Includes reference videos
 - Needed by each operator performing activity or if >2 weeks from first session
 - Setup
 - Deploy to HRF Payload Drawer shelf
 - Ground team connects to rHEALTH unit via HRF PC
 - Perform Practice Trials
 - Lateral mixing of control solution
 - Sample cup filing and machine analysis practice
 - Downlink and ground analysis prior to proceeding
 - Perform Sample Runs
 - Stow/Trash
- Control solutions are limiting factor for launch and session timing
 - Tox O
 - One year shelf life
 - Control solutions will be ordered prior to hardware turnover to maximize on-orbit shelf life

In-flight	Crew Time (min)*	
	Nominal	Reserve
Procedure Review	30	0
Setup (unstow, prep, prime, and functional test)	90	0
Sample Mixing	10	0
Practice Runs	30	
Practice Run - Data Downlink and Analysis (15-30 minute break between timed activities)	--	0
Sample Runs – (half of test matrix, 6 runs, includes replenishing sheath fluid)	115	
Teardown	30	
Total per Session	305 min/ 5.08 hr	0
Total for both sessions (assuming same operator)	580 min/ 9.67 hr	

Sample Letter for Flight	Control Solution* P/N (Manufacturer)	Description	Feature Tested	Applicable Channel(s)	Feature in Raw Data
A	01-1111-42 (Thermo Fisher) 85-0038 T100 75-0149 T100 50-0199-T100 (Tonbo Biosciences)	Antigen-capture <u>OneComp eBeads</u> stained with antibodies: CD3 V500, CD14 V450, CD19 PE	Spectral Overlap	GREEN BLUE ORANGE (respectively to dyes)	Target: 1 distinct amplitude, peaks not repeated on other color channels
B	PPS-6K (Spherotech)	Particle Size Standard Kit -using 4, 6, 10, and 15 μ m	Particle size resolution	FSC	Target: 4 distinct amplitudes
C	RQC-30-5 (Spherotech)	Rainbow QC Calibration Particles, 3 peaks of intensity, all colors	Fluorescence resolution: sensitivity and linearity of the instrument	GREEN BLUE ORANGE	Target: 3 distinct amplitudes
D	A69184 (RUO) or A63492 (IVD) (Beckman Coulter)	Flow-Set Pro Fluorospheres, uniform size and intensity	PMT Optical Precision, alignment	All	Target: Low CV



ISS Increment 64 Flight Engineer Kate Rubins is shown with the HemoCue® device at the Maintenance Work Area (MWA) of the Harmony Module (Node 2)

Successful operations were completed with HemoCue® during January 2021 marking the first-ever real-time hematology performed in space



ISS Increment 64 HemoCue Ops first session in the GRC Telescience Support Center (TSC)

December 28, 2020

Importance and reason for ISS

- Verify the device functions in microgravity
- Microfluidics, sample handling, bubble formation can all be adversely affected by microgravity and operating conditions and constraints

Expected results and how they will advance the field

- **We expect three (3) repeat runs with 4 sample types**
- **Minimum Success Criteria: Data from at least 1 test run from Samples B, C, & D**
 - Number of channels with signal
 - At least 1 scatter channel
 - At least 1 color channel
- Hydrodynamic flow focusing present and functions in zero-g
- “Sample to answer” point of care technology from a single drop of blood, urine, or saliva will greatly advance research capability and medical diagnostics on ISS for crew health

The Need on Earth

Healthcare is inaccessible and inadequate.

Sophisticated lab diagnostics are only available in central laboratory settings in well-resourced countries. Accessible high-performance home-based diagnostics are needed to improve healthcare.

Healthcare should be readily available at our

fingertips. Telemedicine, remote consults, and health apps are very limited without actionable diagnostic information. The majority of doctor's visits require a blood draw or some other diagnostic information. Unfortunately, today this is not possible.

Anyone should be able to peer at their health.

Currently, there is a physician or other medical professional that mediates the interaction with a patient. A patient should be able to take proactive steps to increase their health, like lowering their cholesterol with a better diet, screening for infection status, or checking their blood counts.



Words courtesy
www.rhealth.com

Thank you!

Acknowledgements

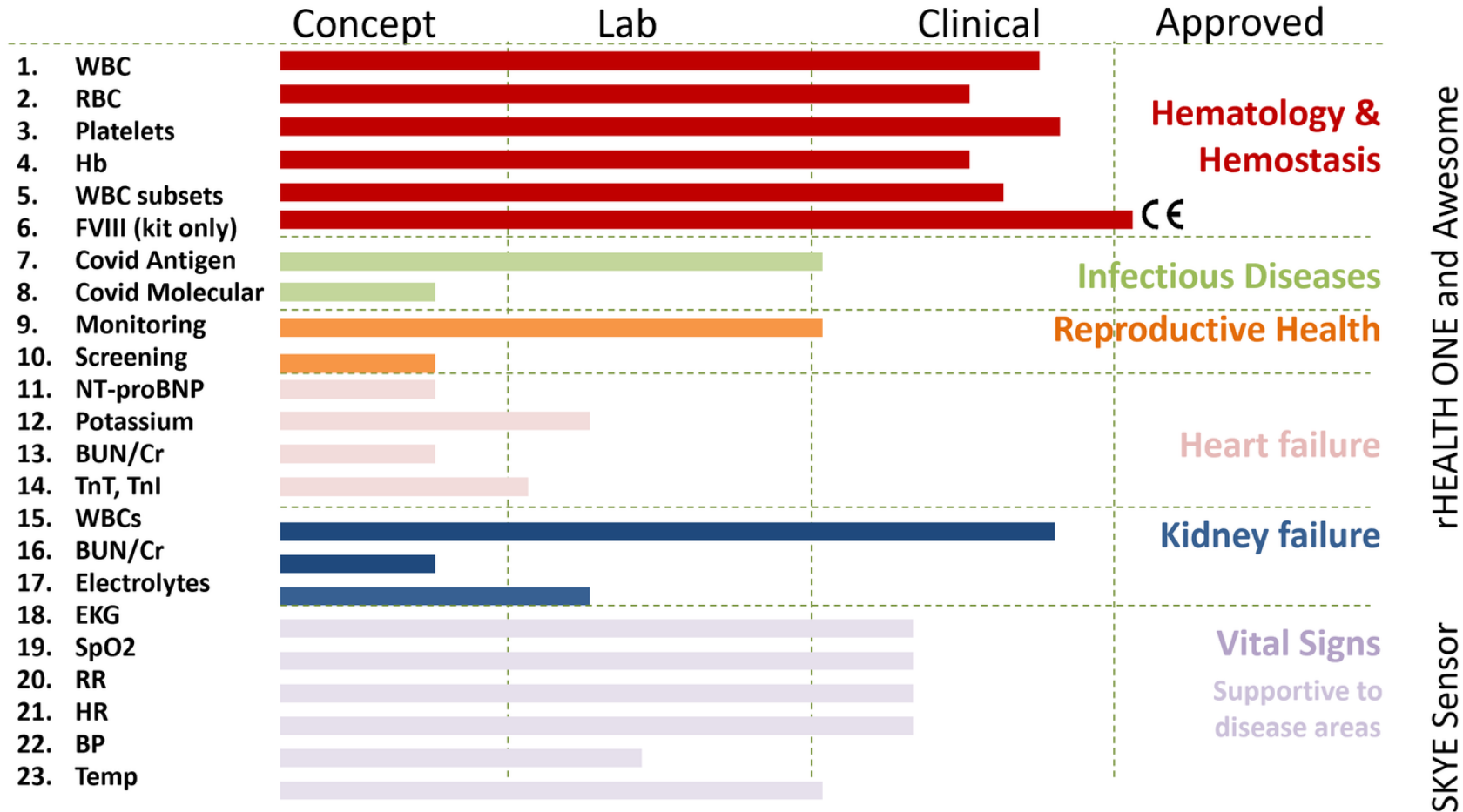
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Russell Valentine/ZIN Technologies
Matt Huffman/ZIN Technologies
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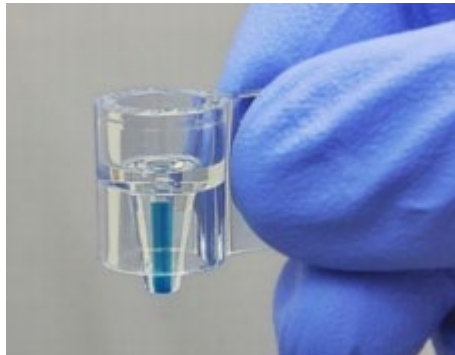


ExMC Key Objectives:

- 1) Sponsor research and technology leading to the development of clinical care capability, medical equipment technology, and medical informatics; and
- 2) Identify and test next generation medical care and crew health maintenance technologies (monitoring technologies, diagnostic capabilities, treatment tools and techniques)



rHEALTH technology test menu and status. Tests are listed for different categories and disease areas. The length of the bars indicate the current development status of each test. Courtesy www.rhealth.com



Sample Cup

- Analyzer
 - Includes modifications
- USB Cable
- Sample Cup (x50)
- 3 mL Syringe (x4)
- 30 mL Syringe (x2)
- Bottle (x4)
- Water Bag (x8)
- Waste Bag (x4)
- Reservoir Bag (x3)
- Test Sample Kit (x8)
 - Shelf life: 1 year from date of manufacture



Copper Tape for EMI protection

Bottle (Sheath Fluid)

Bottle (Cleaning Fluid)

Bottle filled with 2 Water Bags