EXPLORATION LABORATORY ANALYSIS – ARC

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ABSTRACT

The Exploration Laboratory Analysis (ELA) project supports the Exploration Medical Capability (ExMC) risk, *Risk of Inability to Adequately Treat an Ill or Injured Crew Member*, and ExMC Gap 4.05: *Lack of minimally invasive in-flight laboratory capabilities with limited consumables required for diagnosing identified Exploration Medical Conditions*. To mitigate this risk, the availability of inflight laboratory analysis instrumentation has been identified as an essential capability in future exploration missions. Mission architecture poses constraints on equipment and procedures that will be available to treat evidence-based medical conditions according to the Space Medicine Exploration Medical Conditions List (SMEMCL). The SMEMCL provided diagnosis and treatment for the evidence-based medical conditions and hence, a basis for developing ELA functional requirements.

A major task accomplishment in FY11 was the approval of baselined functional requirements by the SMCCB (Space Medicine Configuration Control Board) and HACDCB (Human Adaptation and Countermeasures Control Board). These functional requirements outline the measurements for exploration operational medicine and human research. For operational medicine, specific measurement panels were developed as well as instrument performance specifications. The human research (driven by Human Health and Countermeasures, or HHC, element) portion of the requirements captured the main focus areas of future research and indicated the types of measurements that may be performed for human exploration research. Since there were similarities in the analytical performance of such instruments, ideally ExMC may be able to leverage HHC advances, and vice versa.

A second major task for FY11 was a market survey of lab analysis directed at HHC and ExMC objectives. For HHC, the limitations on instrument mass, power and size were limited to the rack space available on the International Space Station (ISS). Since down mass will occur with less frequency upon retirement of the Space Shuttle, in-situ measurements will be of greater importance to HHC researchers. Thus, the study focused on short-term analytical platform technologies that can accommodate a variety of assays and be flight ready in the next 24-36 months. This study also leveraged the DeVenCI (Defense Venture Catalyst Initiative) results. For ExMC, the measurement panels are clearly defined in the functional requirements. This investigation focused commercial off-the-shelf (COTS) instrumentation and emerging technologies. The COTS instrumentation provided the state-of-the-art capability for most of the measurement panels, but not all the panels or parameters. In addition, the COTS devices suffered from mass, volume and power issues, in some instances, and from a lack of long-term stowage capability, especially for the disposables and/or reagents. Emerging technologies offered promising solutions for the next generation point-of-care devices that are compact (generally handheld) and minimize the mass of disposables, or re-use the device through the miniaturization of detection substrates and minimizing reagent consumption. Finally, longer-term technologies were found to be developing applications for cell phone diagnostics and advancing chemistries that would nearly determine all targets on over-the-counter glucose monitoring instruments.

A final task in FY11 was the release of the ExMC Phase I Small Business Innovation Research (SBIR) topic Smart Phone Driven Blood-Based Diagnostics. This SBIR aimed to advance recent progress in using smart phones as a diagnostic platform. As user applications pervade the field of telemedicine, smart phones provide a robust, reconfigurable platform capable of communications, computations and various functions (i.e., imaging, video, power source, signal processing) that will continue to expand at an accelerated pace. Hence, an opportunity has been identified where NASA may leverage the telemedicine diagnostics applications in resource poor environments such as rural African communities and the military.