

## **SUMMARY OF TECHNICAL INTERCHANGE MEETINGS (TIMs) DESIGNED TO ENABLE EARTH INDEPENDENT MEDICAL OPERATIONS (EIMO)**

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The Exploration Medical Capability Element (ExMC) in NASA's Human Research Program hosted a series of TIMs in 2023-2024 designed to stimulate discussion around specific topics with the goal of enabling EIMO. In context of the thematic constituent elements of EIMO, namely pre-mission planning, acute/emergent/prolonged medical decision making, supply/resource management and task load management, subject matter experts from industry, academia and government (NASA and other Agencies) provided valuable and actionable guidance and recommendations. Earth-based medical experts will remain indispensable for pre-mission planning, however, management of acute/emergent medical contingencies will require a gradual transition of medical care and decision making from terrestrial to space-based assets to enable support of astronaut health and performance and reduce overall mission risk. Key to achieving these enhancements is providing an integrated data system platform capable of utilizing multiple data streams in concert with a variety of on-board databases and passive monitoring of video and wearable sensors to enable a multi-modal, agentic AI-based clinical decision support system (CDSS) to support crew medical officer (CMO) medical decision-making. The EIMO series of TIMs (I-V) have proven to be instructive and portend a significant paradigm shift will be necessary to maintain crew health and performance on exploration class missions. Importantly, since the expected paradigm shift will be significantly different from the methods of operation that have been employed for the majority of missions from the inception of human spaceflight to date, any proposed methods must be deployed in the setting of ongoing operations early and be "tested, reviewed and practiced" while reliable back-up is available to facilitate an Enterprise-wide level of comfort and acceptance. Serious constraints on data transmission coupled with a large and expanding universe of on-board medical informatics data streams will necessitate implementation of a CDSS to supplant the current reliance on support provided by ground-based SMEs. Establishment of trust in the system by CMO/crew and the ground-based medical support team will be essential. Co-development of a CDSS with industry partners will assure that state of the art tools can be employed, and industry efficiencies can be leveraged. Training regimens, materials and tools must evolve to be responsive (just-in-time training) and facilitate autonomous execution of procedures. Proficiency metrics should be established and be based on validated competencies or milestones as opposed to a prescribed number of training hours. Training should be prioritized for broad, translatable skills that have universal application across a variety of medical conditions. Repetition was deemed to be the key to achieving proficiency and emphasis should lie in procedural training which is known to extinguish more rapidly than diagnostic skills. Advanced tools, *e.g.*, extended reality, can provide more realistic and effective training. Use of advanced probabilistic risk assessment tools will be essential to optimize the medical system capability while carefully balancing risk relative to mass/power/volume limitations. Importance of factoring use-life of medical supplies and maintaining awareness of redundancy and opportunity to re-purpose under off nominal situations was emphasized. Consideration of adopting optimized performance standards *vs.* "good-enough" performance thresholds is warranted. The use of legacy systems as opposed to creating new systems may be preferable. Managing task load and associated cognitive load will be essential to maintain operational safety and behavioral health. ExMC aspires to create a shared EIMO paradigm and strategic vision for advancing medical system design through novel technologies, training, protocols, and support capabilities, built upon the spirit of successful strategies and innovations over the past six decades of space medicine operations.