INTEGRATED MEDICAL MODEL VERIFICATION, VALIDATION, AND CREDIBILITY

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BACKGROUND: The Integrated Medical Model (IMM) is designed to forecast relative changes for a specified set of crew health and mission success risk metrics by using a probabilistic (stochastic process) model based on historical data, cohort data, and subject matter expert opinion. A probabilistic approach is taken because exact (deterministic) results would not appropriately reflect the uncertainty in the IMM inputs. Once the IMM was conceptualized, a plan was needed to rigorously assess input information, framework and code, and output results of the IMM, and ensure that end user requests and requirements were considered during all stages of model development and implementation.

METHODS: In 2008, the IMM team developed a comprehensive verification and validation (V&V) plan [1], which specified internal and external review criteria encompassing 1) verification of data and IMM structure to ensure proper implementation of the IMM, 2) several validation techniques to confirm that the simulation capability of the IMM appropriately represents occurrences and consequences of medical conditions during space missions, and 3) credibility processes to develop user confidence in the information derived from the IMM. When the NASA-STD-7009 (7009) [2] was published, the IMM team updated their verification, validation, and credibility (VV&C) project plan to meet 7009 requirements and include 7009 tools in reporting VV&C status of the IMM.

RESULTS: IMM VV&C updates are compiled recurrently and include 7009 Compliance and Credibility matrices, IMM V&V Plan status, and a synopsis of any changes or updates to the IMM during the reporting period. Reporting tools have evolved over the lifetime of the IMM project to better communicate VV&C status. This has included refining original 7009 methodology with augmentation from the NASA-STD-7009 Guidance Document. End user requests and requirements are being satisfied as evidenced by ISS Program acceptance of IMM risk forecasts, transition to an operational model and simulation tool, and completion of service requests from a broad end user consortium including operations, science and technology planning, and exploration planning.

CONCLUSIONS: The VV&C approach established by the IMM project of combining the IMM V&V plan with 7009 requirements is comprehensive and includes the involvement of end users at every stage in IMM evolution. Methods and techniques used to quantify the VV&C status of the IMM have not only received approval from the local NASA community but have also garnered recognition by other federal agencies seeking to develop similar guidelines in the medical modeling community.

REFERENCES: