systems can involve crew and software during nominal or contingency operations, including medical contingencies. The AS portfolio includes a task for Autonomous Medical Operations (AMO) for Exploration.

Long-duration space missions will require a Chief Medical Officer to handle both routine medical check-ups, as well as issues of emergent care as might arise while the crew is out of contact with Earth. The objective of AMO is to develop a Medical Decision Support System (MDSS) to enable augmentation of astronauts' capabilities. The MDSS will support multiple stages of clinical workflow on such missions. Such a system is not intended to replace decision-making capabilities of a medical officer or crew, but rather to support their medical actions through rapid and assured access to multiple on-board databases, including patient electronic health records, direct radiographic image analysis from on-board tests, medical notes analysis and interpretation, physiological stress tests, and adverse drug-drug interactions tailored to each crew member.

FY17 efforts are directed at a proof-of-concept demonstration of MDSS to evaluate its design, and to carry out analysis that scopes the effort for a full development of an MDSS. The full MDSS will operate within a Medical Data Architecture, being developed now at NASA Ames in the Human Research Program (HRP)'s Exploration Medical Capability (ExMC) Element. HRP/ExMC is the prime customer and will provide the testing and evaluation platform for the developed products. ExMC Chief Scientist at JSC will define the functional requirements to which the MDSS must be built, as well as providing the medical operations expertise.

The primary target applications, for early demonstration, are specific ultrasound biosensor smart toolkits primarily directed at identification of pericardial effusion and at cardiac arrhythmias. Both these may be reasonably expected to develop on long-duration missions due to high stress levels in the crew as well as physiological movement of fluids and organs into positions different from ground-based settings because of microgravity. Yet, it is important to distinguish adaptations from true medical pathologies. The MDSS effort is tailored to discriminate between such settings using ultrasound methods and detailed feature identification across collected biosensor images, each of which feed logical analysis of medical risk and development of Recommender Systems that support a medical officer.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

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