Human presence in space requires an understanding of the effects of the space environment on the physiological systems of the body. The objective of this subtopic is to sponsor applied research leading to the development of noninvasive, unobtrusive medical devices that will mitigate crew health, safety, and performance risks during future flight missions to the Moon and Mars. Medical diagnostic and monitoring devices are critical for providing health care and medical intervention during missions, particularly extended-duration spaceflight to the Moon and Mars. Of particular interest are devices with minimized mass, volume, and power consumption, and capable of multiple functions. Design enhancements that improve the operation, design reliability, and maintainability of medical devices in the space environment are also sought. Of additional consideration are innovative instrumentation automation, ease of use, improved astronaut comfort, and easy-to-read information displays.

Major research disciplines include endocrinology, hematology, microbiology, muscle physiology, pharmacology, drug delivery systems, and mechanistic changes in neurovestibular physiology.

Innovations in the following areas are sought:

- Biomedical monitoring, sensing, and analysis (including the acquisition, processing, communication, and display) of electrical, physical, or chemical aspects of a human’s health or physiological state.

- Instrumentation to be used for in-flight and ground-based studies for reliable and accurate noninvasive monitoring of human physiological functions such as the musculoskeletal, neurological, gastrointestinal, and hematological systems.

- Noninvasive biosensors for real-time monitoring of blood and urine chemistry including gases, calcium ions, electrolytes, proteins, lipids, and hormones.

- In-flight specimen analysis to evaluate physiological, metabolic, and pharmacological responses of astronauts.

- Instrumentation to provide quantitative data to establish the effectiveness of an exercise regimen in ground-based research, and to measure bone strain in the hip, heel, and lumbar spine during exercise.
• Assessment of gas bubble formation or growth in the body after in-flight or ground-based decompression, and to prevent or minimize associated decompression sickness.

• In-flight assessment of the metabolism of proteins, carbohydrates, lipids, vitamins, and minerals.

• Smart sensors capable of sensor data processing and sensor reconfiguration.

• Small, portable, medical imaging diagnostic instrumentation.