

## Direct Signal-to-Noise Quality Comparison between an Electronic and Conventional Stethoscope aboard the International Space Station

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**Introduction:** Evaluation of heart, lung, and bowel sounds is routinely performed with the use of a stethoscope to help detect a broad range of medical conditions. Stethoscope acquired information is even more valuable in a resource limited environments such as the International Space Station (ISS) where additional testing is not available. The high ambient noise level aboard the ISS poses a specific challenge to auscultation by stethoscope. An electronic stethoscope's ambient noise-reduction, greater sound amplification, recording capabilities, and sound visualization software may be an advantage to a conventional stethoscope in this environment.

**Methods:** A single operator rated signal-to-noise quality from a conventional stethoscope (Littman 2218BE) and an electronic stethoscope (Litmann 3200). Borborygmi, pulmonic, and cardiac sound quality was ranked with both stethoscopes. Signal-to-noise rankings were performed on a 1 to 10 subjective scale with 1 being inaudible, 6 the expected quality in an emergency department, 8 the expected quality in a clinic, and 10 the clearest possible quality. Testing took place in the Japanese Pressurized Module (JPM), Unity (Node 2), Destiny (US Lab), Tranquility (Node 3), and the Cupola of the International Space Station. All examinations were conducted at a single point in time.

**Results:** The electronic stethoscope's performance ranked higher than the conventional stethoscope for each body sound in all modules tested. The electronic stethoscope's sound quality was rated between 7 and 10 in all modules tested. In comparison, the traditional stethoscope's sound quality was rated between 4 and 7. The signal to noise ratio of borborygmi showed the biggest difference between stethoscopes. In the modules tested, the auscultation of borborygmi was rated between 5 and 7 by the conventional stethoscope and consistently 10 by the electronic stethoscope.

**Discussion:** This stethoscope comparison was limited to a single operator. However, we believe the results are noteworthy. The electronic stethoscope out performed the traditional stethoscope in each direct comparison. Consideration should be made to incorporate an electronic stethoscope into current and future space vehicle medical kits.