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REDUCTION OF HEALTH RISKS DURING LONG TERM SPACE MISSIONS BY PERSONALIZED  
QUANTIFICATION OF VITAMIN D PRODUCTION

**Abstract**

Maintaining muscle and bone mass, regulation of the immune system and entrainment of the circadian clock are vital challenges when planning long term space missions in the future. In all of these processes, vitamin D plays an important role. However, it has been shown that depending on preexisting health conditions, the amount of vitamin D required by the individual can vary greatly. Vitamin D deficiency in the body can result in the loss of bone mass and increase the chance for the development of depression. Both risks are also inherent to prolonged space missions and can be exacerbated by the lack of UV radiation exposure in the space craft. Since vitamin D is produced when the skin is exposed to UV radiation, we have developed an indirect measurement system for the quantification of the personal dose of UV light exposure that takes into account the preexisting individual physiological conditions to estimate the needed amount of vitamin D for a human being in space and on earth. The personalized profiles can then be applied to an upcoming space mission and support the well-being of the crew by reducing the amount of bone mass lost and the risk for depressive episodes. The wearable unit includes sensors for UV light and visible light quantification to not just deliver an estimate of the vitamin D production but also on the presence of light cues that are needed by the body for the entrainment of the circadian clock. In addition, the system can be attached at different positions on the body to improve the quality of the collected data. The measurements are transmitted wirelessly to any existing Bluetooth 4.0 LE capable device and processed by a personalized algorithm to give an estimate on the amount of vitamin D produced as well as on the proper stimulation of the circadian clock by external factors. The unit can be used as a standalone system or be integrated in multi module life support systems in space and on earth.