EVOLUTION OF SPACEFLIGHT RENAL STONE RISKS AND UPDATE TO THE NASA HUMAN RESEARCH PROGRAM (HRP) RENAL STONE EVIDENCE REPORT AND INTEGRATED CONCEPT OF OPERATIONS

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BACKGROUND: The NASA HRP Evidence Report on the *Risk of Renal Stone Formation* is being updated based on new information obtained from 9 years of data from NASA's astronaut renal stone surveillance program. In addition, the Concept of Operations for missions beyond Low Earth Orbit (LEO) was created to supplement the Evidence Report, and the NASA clinical practice guideline (CPG) for renal stone surveillance was updated.

OVERVIEW: A literature review was performed to evaluate the state of literature regarding renal stone prevention, mitigation, and management both in terrestrial and spaceflight environments. Current renal stone treatment guidelines for the ISS, which were created by the Inflight Clinical Medicine Working Group and approved by the Multilateral Medical Operations Panel (MMOP) were reviewed, as well as recent ultrasound technology demonstrations onboard the ISS. This information was used in conjunction with emerging evidence from the surveillance program to update the Evidence Report and in-flight Concept of Operations.

DISCUSSION: There are known and emerging renal stone prevention strategies including astronaut selection, the use of medications and resistive exercise, early diagnosis with regular urine studies and ultrasound imaging. In-flight treatment options include pharmaceuticals, use of lithotripsy and propulsive ultrasound, placement of percutaneous drains and other modalities. This information is useful to gauge future risks and update our strategies for prevention and management of renal stones in astronauts to reduce the risk of in-flight renal stone colic that could cause morbidity and mission impact.