



An Evidence Base for Human Spaceflight Risks in Wikipedia



Craig Kundrot¹, Jennifer Steil², Sarah Lumpkins³, Neal Pellis²

¹Human Research Program, NASA Johnson Space Center, 2101 NASA Parkway, Houston, Texas 77058

²Universities Space Research Association, 3600 Bay Area Blvd, Houston, Texas 77058

³Wyle Integrated Science and Engineering Group, 16055 Space Center, Houston, TX 77058

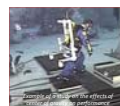


Abstract

NASA's Human Research Program (HRP) is focused on understanding and mitigating thirty two risks to crew health and performance in exploration missions beyond low Earth orbit. The HRP has developed an evidence report for each of the risks. Most evidence reports are a brief review article describing the evidence related to a specified risk, written at a level appropriate for the scientifically-educated, non-specialist reader. Each evidence report captured the current state of knowledge from both research and operations. Two limitations of the evidence reports have become apparent: 1) they are updated infrequently and 2) they do not take full advantage of the expertise available in other space agencies and in related fields of terrestrial research. Therefore, the HRP is experimenting with the use of Wikipedia articles as a repository for evidence. Wikipedia's accessibility to the international space flight community and researchers in related terrestrial fields creates the opportunity to generate a more timely and comprehensive evidence base. Initial Wikipedia articles were populated for seven risks using a subset of the information in the HRP-approved evidence reports: [Fatigue and Sleep Loss](#), [Treating An Ill or Injured Crew Member](#), [Radiation Carcinogenesis](#), [Visual Impairment and Intracranial Pressure](#), [Renal Stone Formation](#), [Team Cohesion](#), and [Intervertebral Disc Damage](#). Since the initial articles were created, there have been additions to these Wikipedia articles, including content from sources outside the HRP, and editorial changes to the pages. We will report on the nature of the contributions made after the initial articles were created, the comprehensiveness of the resulting Wikipedia articles, and the effort required to maintain quality control of the content. The Wikipedia approach will also be compared to wiki efforts that exert more traditional editorial control of content prior to posting.

Human Research Program

The goal of HRP is to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration.



The 32 Risks



1. Risk Factor of Inadequate Nutrition
2. Risk of Acute and Late Central Nervous System Effects from Radiation Exposure
3. Risk of Acute Radiation Syndromes Due to Solar Particle Events (SPEs)
4. Risk of Adverse Behavioral Conditions and Psychiatric Disorders
5. Risk of Adverse Health Effects Due to Alterations in Host-Microorganism Interactions
6. Risk of Adverse Health Effects of Exposure to Dust and Volatiles During Exploration of Celestial Bodies
7. Risk of an Incompatible Vehicle/Habitat Design
8. Risk of Bone Fracture
9. Risk of Cardiac Rhythm Problems
10. Risk of Critically Relevant Unpredicted Effects of Medication
11. Risk of Compromised EVA Performance and Crew Health Due to Inadequate EVA Suit Systems
12. Risk of Crew Adverse Health Events Due to Altered Immune Response
13. Risk of Decompression Sickness
14. Risk of Degenerative Tissue Or Other Health Effects from Radiation Exposure
15. Risk of Early Onset Osteoporosis Due to Spaceflight
16. Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Adaptations Associated with Space Flight
17. Risk of Impaired Performance Due to Reduced Muscle Mass, Strength, and Endurance
18. Risk of Inadequate Design of Human and Automation/Robotic Integration
19. Risk of Inadequate Human-Computer Interaction
20. Risk of Injury from Dynamic Loads
21. Risk of Intervertebral Disk Damage
22. Risk of Orthostatic Intolerance During Re-Exposure to Gravity
23. Risk of Performance Decrement and Crew Stress Due to an Inadequate Food System
24. Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychological Adaptation within a Team
25. Risk of Performance Errors Due to Fatigue Resulting from Sleep Loss, Circadian Desynchronization, Extended Wakefulness, and Work Overload
26. Risk of Performance Errors Due to Training Deficiencies
27. Risk of Radiation Carcinogenesis
28. Risk of Reduced Physical Performance Capabilities Due to Reduced Aerobic Capacity
29. Risk of Renal Stone Formation
30. Risk of Spaceflight-Induced Intracranial Hypertension/Vision Alterations
31. Risk of Unacceptable Health and Mission Outcomes Due to Limitations of In-Flight Medical Capabilities
- 32.

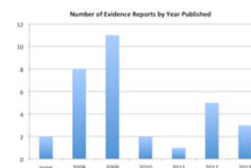
1st Generation Evidence Base

- 2008 Evidence Book
 - One volume
 - One chapter for each HRP risk
 - Review paper format
 - Aimed at scientifically-educated, non-specialist reader
 - Current state of knowledge from both research and operations.
 - Authors
 - Human Research Program
 - National Space Biomedical Research Institute



Limitations

- Limited authorship
 - NASA and NSBRI
 - Missing ISS international partners
 - Missing researchers studying related terrestrial issues
- Laborious update process
 - Resulting in "all or none" updates
- Infrequent updates

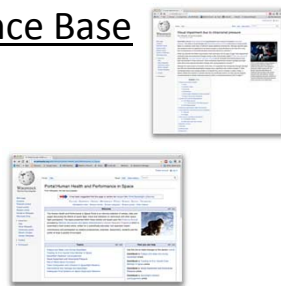


Note: Some Evidence Reports have been supplemented by a bibliography or additional report

2nd Generation Evidence Base

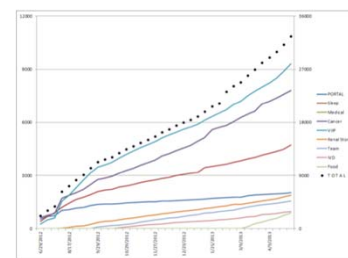
- The Gene Wiki precedent
 - Enable the creation of a collaboratively written, continuously updated, high quality review article for all (~25,000) human genes.
 - Wikipedia
 - "Stub" articles for each gene in standardized format
 - Users add and refine content
 - en.wikipedia.org/wiki/Gene_Wiki
- The HRP implementation
 - Portal page in Wikipedia
 - Main article for each risk
 - Subarticles as needed
 - Links to related Wikipedia content
 - Summary of HRP-approved Evidence Report

http://en.wikipedia.org/wiki/Portal:Human_Health_and_Performance_in_Space



Strengths

- Extremely accessible
 - Reading
 - Contributing
- Many "hits"
- Links to other wiki content



Type of Contribution	Number of Contributions
Citation	99
Sentence added or modified	175
Paragraph	18

3rd Generation Evidence Base

- Wiki based, but not Wikipedia
- Editorially controlled
 - Editorial Board for each Evidence Report
- Initial content = HRP-approved Evidence Reports
 - Verbatim copy of full Evidence Report
- Contributions
 - Default: pre-screened by editorial board
 - Option: Pre-approved contributors provide input that is screened post facto by editorial board
- Coming Fall 2013
 - humanresearchroadmap.nasa.gov/Evidence



Limitations

- Wikipedia rules for content
 - Cannot copy Evidence Reports
 - Must summarize Evidence Reports
 - The resulting article is a summary of a review
- Few contributions
 - Net loss of content
 - Workload to maintain thriving articles is unknown

Conclusion

	First Generation	Second Generation	Third Generation
Pros	Good content	Viewed often; very open to contributions	Incremental additions to review articles with editorial control
Cons	Limited authorship; infrequent updates	Summary of reviews; very few contributions	?