

COE CST 3rd Annual Technical Meeting:

Task 256: Tolerance of Centrifuge-induced G-force by Disease State

James Vanderploeg, MD, MPH



October 30th, 2013



Disclaimers

- Will discuss off-label use of commercially-available physiologic monitoring device, Equivital EQ01-1000 (Hidalgo Ltd., Cambridge, United Kingdom)
- Hidalgo Ltd provides technical expertise and materials to investigators for the purpose of research

Disclaimers

- NASTAR Center provided centrifuge time to UTMB at no charge under the FAA COE CST relationship
- No other financial relationships to disclose

Overview

- Team Members
- Purpose of Task
- Research Methodology
- Results
- Conclusions
- Next Steps
- Contact Information

Team Members

- **PI: James Vanderploeg, MD, MPH** (UTMB Aerospace Medicine)
- **Co-I: Rebecca Blue, MD, MPH** (UTMB Aerospace Medicine)
- **Co-I: Tarah Castleberry, DO, MPH** (UTMB Aerospace Medicine)
- **Co-I: Charles Mathers, MD, MPH** (UTMB Aerospace Medicine)
- **Co-I: Johnené Vardiman, LCDC** (UTMB Aerospace Medicine)
- **Student: James Pattarini, MD, MPH** (UTMB Aerospace Medicine)
- **Student: David Reyes, MD, MPH** (UTMB Aerospace Medicine)
- **Student: Robert Mulcahy, MD** (UTMB Aerospace Medicine)
- **Brienna Henwood** (NASTAR Center)
- **Program Manager: Ken Davidian** (FAA)
- **Technical Monitor: Henry Lampazzi**

NASTAR Center



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Purpose of Task

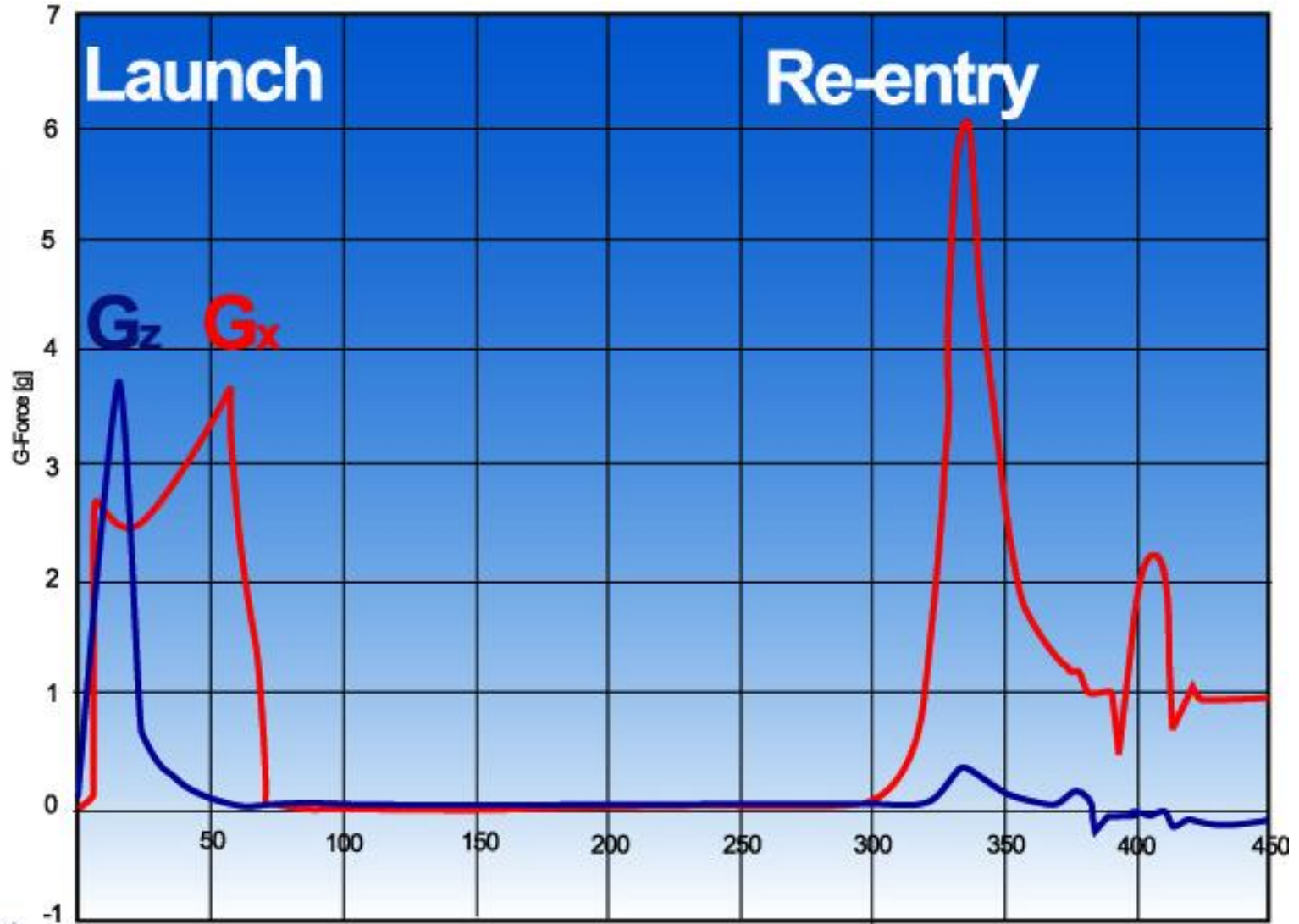
- Purpose:
 - Evaluate subjects with defined disease states under the G-loads expected during commercial space flights using centrifuge-induced G-forces
- Disease States
 - Controlled cardiovascular/coronary disease
 - Controlled hypertension
 - Controlled diabetes
 - Pulmonary disease
 - Spinal disease or injury

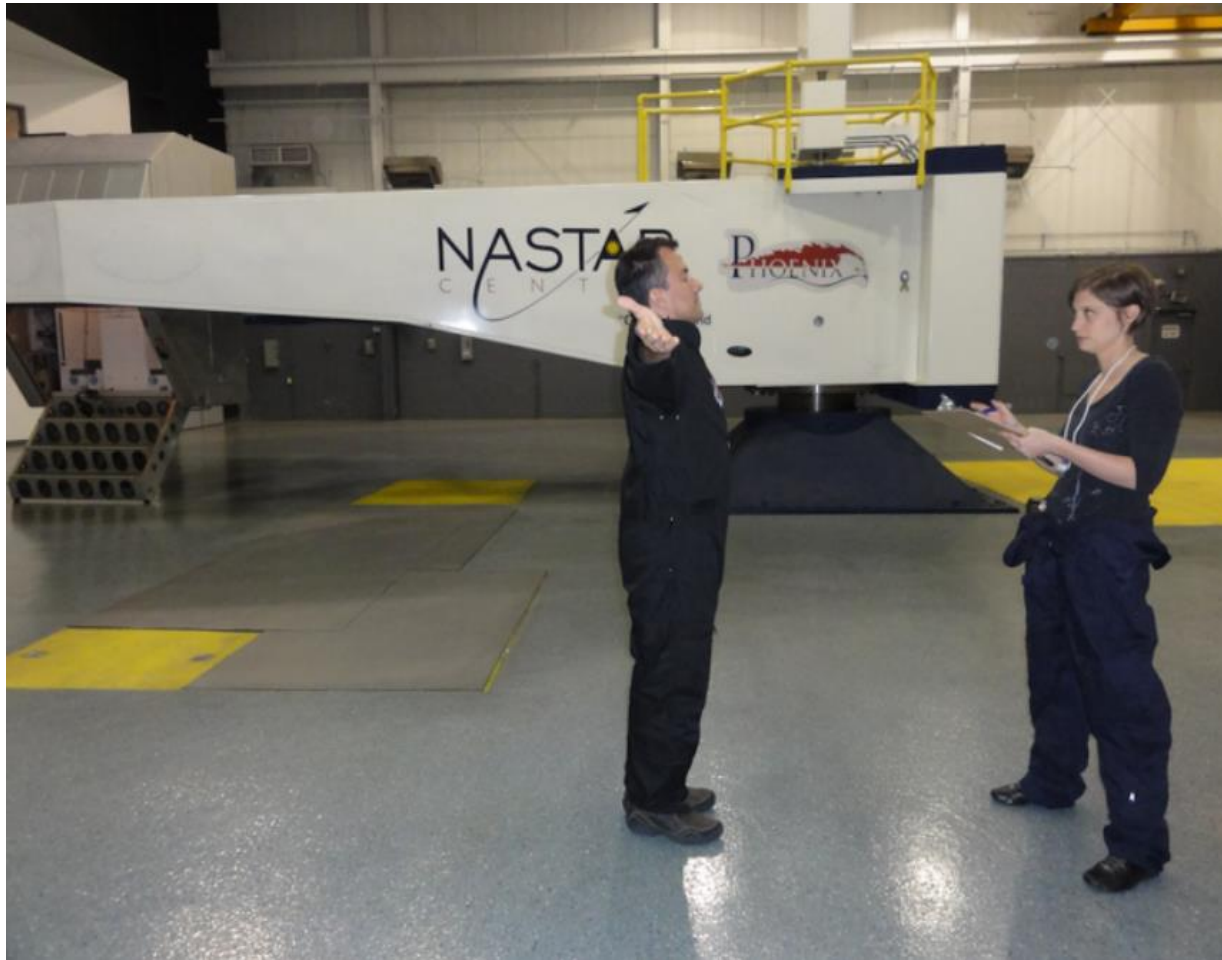
Research Methodology

- Volunteers were recruited for participation based upon their suitability for each of five disease categories (heart disease, lung disease, back or neck problems, diabetes, hypertension) or a control group.
- Subjects underwent 7 centrifuge runs over two days.

Research Methodology

- Day 1 consisted of:
 - Two +Gz runs (peak=+3.5Gz)
 - Two +Gx runs (peak=+6.0Gx)
- Day 2 consisted of three runs approximating suborbital spaceflight profiles
 - Combined +Gx and +Gz
 - Peak +6.0Gx/+4.0Gz





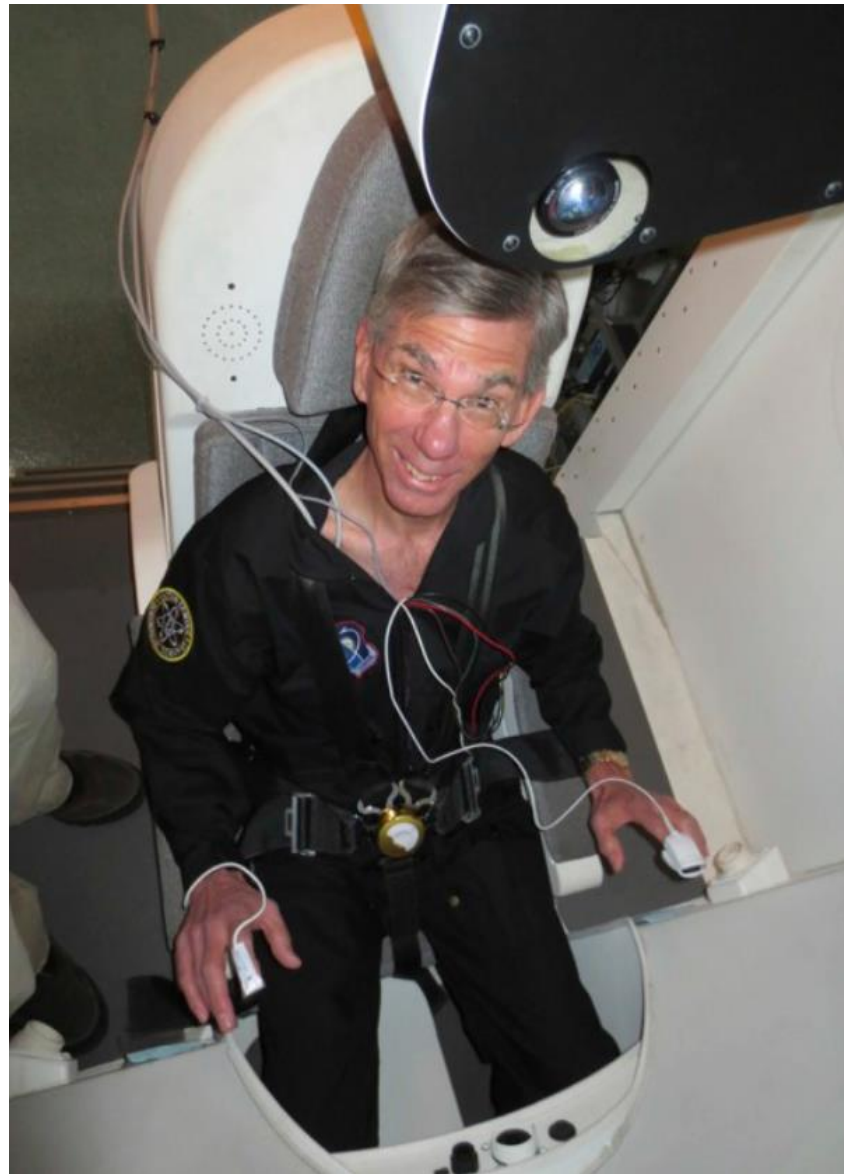
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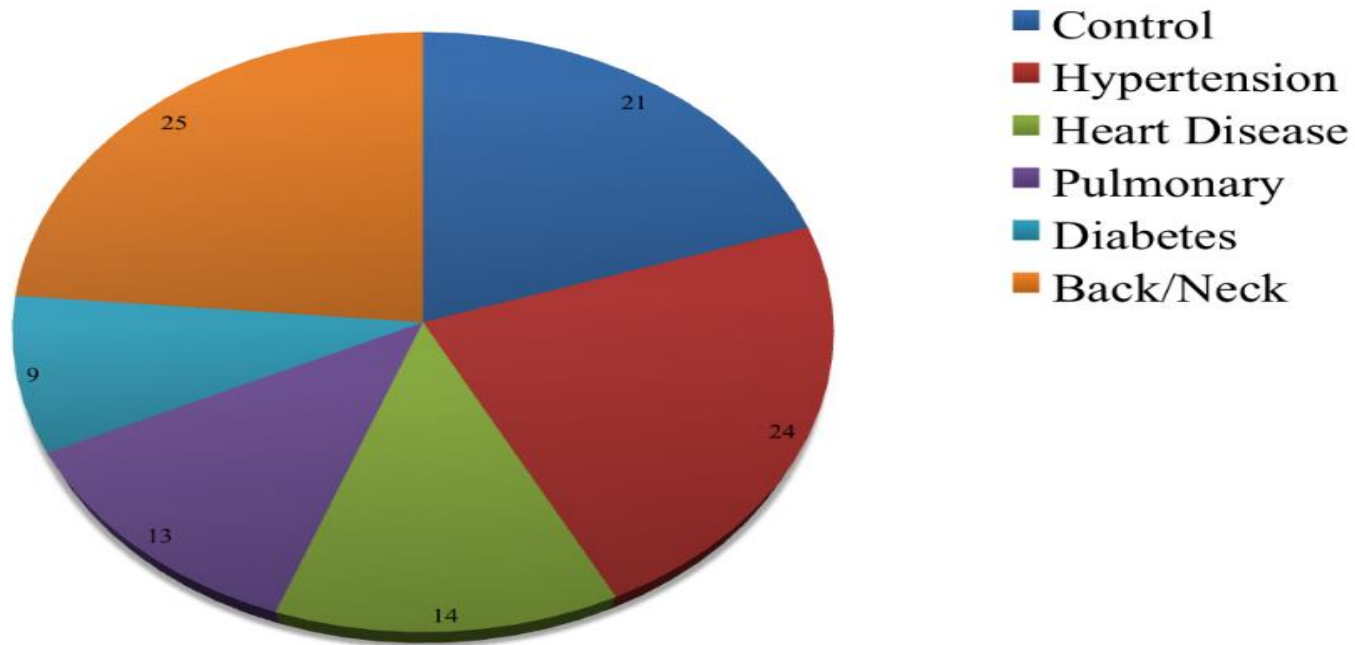




Research Methodology

- Data collected included:
 - Blood pressure
 - Electrocardiogram
 - Pulse oximetry
 - Neurovestibular exams
 - Post-run questionnaires regarding:
 - Motion sickness, disorientation, grey-out, and other symptoms.

Past Medical History of Participants



Results

- A total of 77 subjects have participated thus far in centrifuge trials
 - Age range 22-73 (average 45)
 - Average BMI 26, range 18.9-40.7
- 84 subjects by study completion (115 data points)

Results

- The most common cause for disqualification was severe and uncontrolled medical or psychiatric disease.
- Two subjects voluntarily withdrew from the second day of testing for anxiety reasons
- Despite significant medical history, no subject has experienced significant adverse or abnormal physiological responses to centrifuge profiles.

Conclusion

- Results thus far suggest that most individuals with well-controlled medical conditions can withstand acceleration forces involved in launch and landing profiles of commercial spaceflight vehicles.
- Further investigation will help determine which medical conditions or devices present significant risks during suborbital flight and beyond.

Next Steps

- Complete training and evaluation using the NASTAR centrifuge
- Perform data analysis
- Publish results

Contact Information

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Task 256: Tolerance of Centrifuge-induced G-force by Disease State

Project At-A-Glance

- University: The University of Texas Medical Branch
- Principal Investigator: James Vanderploeg, MD
- Student Researchers: James Pattarini, MD
David Reyes, MD, Robert Mulcahy, MD

Relevance to Commercial Spaceflight Industry

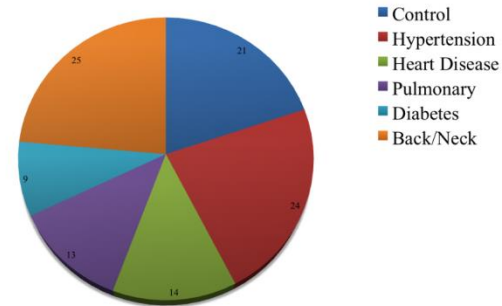
- There is little to no data on how individuals with chronic disease will perform in a high-performance environment such as commercial spaceflight. This study will provide data on how individuals with chronic disease respond to G-force

Statement of Work

- Characterization of responses of individuals with common medical conditions to G-force
- Development of risk mitigation strategies for individuals with those medical conditions



Past Medical History of Participants



Status

- Complete training and evaluation using the NASTAR centrifuge

Future Work

- Perform data analysis
- Publish results
- Develop optimal acceleration training protocols for passengers