

# COE CST 3<sup>rd</sup> Annual Technical Meeting:

## Task 255: Validation of Non- Invasive Biomedical Monitoring in Centrifuge- Simulated Suborbital Spaceflight

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Center of Excellence for  
Commercial Space Transportation



# 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 partners with UTMB to provide no-cost centrifuge time for research
  - 112 days
  - Value of contribution: 3.4 million
- No other financial relationships to disclose

# Overview

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

# Team Members

- **PI: Richard Jennings, MD, MS; Tarah Castleberry, DO, MPH (UTMB Aerospace Medicine)**
- **Co-I: James Vanderploeg, MD, MPH (UTMB Aerospace Medicine)**
- **Co-I: Rebecca Blue, MD, MPH (UTMB Aerospace Medicine)**
- **Student: Alejandro Garbino, MD, PhD (Baylor College of Medicine)**
- **Industry Partner: Brienna Henwood (NASTAR Center)**
- **Program Manager: Ken Davidian (FAA)**
- **Technical Monitor: Henry Lampazzi**

# Purpose of Task

- Purpose:
  - Identify the utility of a commercial, non-invasive, biomedical monitoring device to support operational monitoring needs in a centrifuge-simulated suborbital spaceflight experience.

# NASTAR Center



**COE CST Third Annual Technical Meeting (ATM3)  
October 28-30, 2013**

# Study Hardware



<http://cdn.medgadget.com/wp-content/uploads//2013/01/Equivital-belt-large.jpg>

<http://vivonoetics.com/wp-content/uploads/2012/04/SEM02-300x210.jpg>



# Research Methodology

- Physiological parameters, including:
  - Heart rate
  - Respiratory rate
  - Pulse Oximetry
  - Tri-axial acceleration
- Physiologic data were synchronized with standard electrocardiogram monitoring for validation

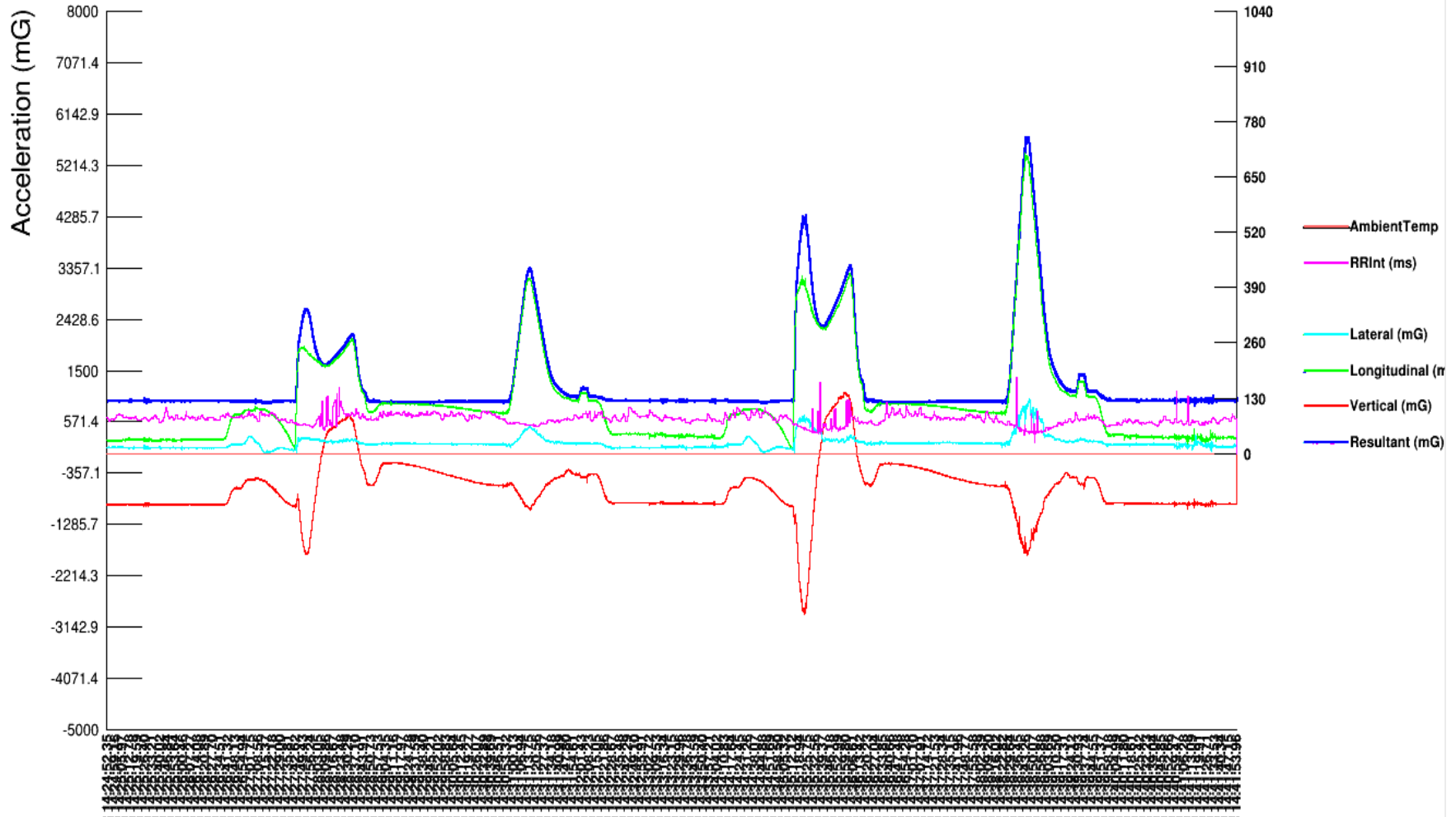
# Research Methodology

- Instrumented subjects underwent 7 centrifuge runs over two days
  - Day 1 consisted of two +Gz runs (peak=+3.5Gz) and two +Gx runs (peak=+6.0Gx)
  - Day 2 consisted of three runs approximating suborbital spaceflight (combined +Gx and +Gz).

# Results

- The device performed well during the centrifuge profiles, providing hemodynamic data with little disruption of signal
- Accelerometer data were reliably synchronized with centrifuge acceleration profiles and served as excellent run-timing markers for hemodynamic data

# FAA/CoE UTMB Centrifuge



# Conclusion

- Despite the significant acceleration exposures, the monitoring system performed well and provided accurate and reliable hemodynamic monitoring of subjects
- Limitations of the device include difficulty in identifying altered electrocardiographic morphology due to the off-nominal electrode placement, cumbersome analysis techniques, and limited harness size to accommodate larger subjects.

# 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

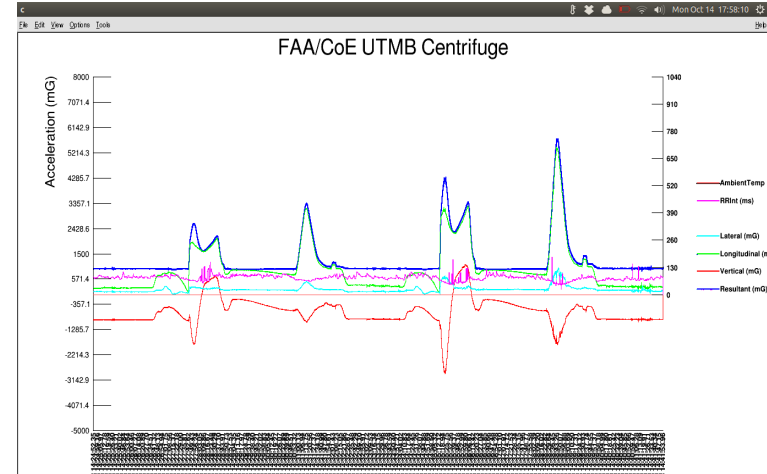
- University: The University of Texas Medical Branch
- Principal Investigator: Tarah Castleberry, DO, MPH
- Student Researchers: Alejandro Garbino, MD, PhD

## Relevance to Commercial Spaceflight Industry

- Commercial spaceflight participants (SFPs) represent a population with potentially significant medical problems that may warrant in-flight medical monitoring
- Commercial SFPs may be hesitant to wear highly invasive, obtrusive monitoring equipment

## Statement of Work

- Identify the utility of a commercial, non-invasive, biomedical monitoring device to support operational monitoring needs in a centrifuge-simulated suborbital spaceflight experience
- Volunteers wearing the monitoring device experienced G-forces simulating a commercial spaceflight.



## Status

- Complete evaluation using the NASTAR centrifuge

## Future Work

- Perform data analysis
- Publish results

