Objective: Define successive bed rest campaigns leading to a potential VIIP countermeasure

To determine if the analog is successful, changes need to occur in following outcome measures (dependent variables):
• Intracranial pressure
• Retinal nerve fiber layer
• Choroidal engorgement
• Globe flattening
• Axial biometry
• Optic nerve sheath diameter distention
• Cycloplegic refraction
• Visual acuity

Study parameters (independent variables) to include:
• CO₂
• Sodium
• Exercise (resistive & aerobic)
• Strict tilt angle

What information can the currently defined studies provide?
• Karina/Joerne enVIIP: \(\angle 6^\circ, 12^\circ, 18^\circ\) + eye changes; \(\angle 12^\circ\) w/ 1% CO₂; \(\angle 12^\circ\) + LBNP
• Vascular Compliance: Compares effects of more and less compliance
  • VIIP strongly prefers to add CO₂ to Vascular Compliance
• Vizzeri/Laurie: 1 hour with 1% CO₂ at \(\angle 6^\circ\)
  • VIIP prefers to add 2 compliance groups and longer duration
• Scott: Effects of exercise modalities at \(\angle 15^\circ\)
• NSBRI Pilot – Confirms facility capabilities for CO₂ administration, etc. Defines tilt \(\angle\).
  • VIIP prefers to do multiple tilts \(\angle 6^\circ, 9^\circ, 12^\circ\) with 2 compliance groups (unless another study identifies optimum angle e.g. 9 degrees)
Pilot CO2

Expected study parameters:
• 24 hours at $\angle 6^\circ$ Head Down Tilt (HDT)
• CO$_2$ at 0.5% - 1%
• Data collection mirrors ISS Ocular Health
• Prefer 2 Compliance groups
• Sodium levels ??
• N = ??

Assumptions:
• NSBRI sponsored
• Studies completed before this campaign begins:
  • Karina/Joern enVIIP: 5 hrs. at enviHab
  • Location: enviHab
**Acute CO₂**


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**Preferred Study parameters:**

- 5 - 7 days at $\angle 12^\circ$ HDT or 7 - 10 days at $\angle 9^\circ$ HDT or 10 - 14 days at $\angle 6^\circ$ HDT
  
  (the tilt angle and duration should be defined by previous studies and what elicits VIIP related change)

- CO₂ at 0.5% - 1% depending on duration and safety
- 2 compliance groups – high (females) and low
- Sodium levels similar to ISS (fixed/constrained)
- N = ?

**Assumptions:**

- Studies completed before this campaign begins:
  - Karina Bowman / Joern Rittweger 5 hrs. at enviHab
  - NSBRI Pilot 24-hour with CO2 at enviHab
  - Vascular Compliance bedrest at UTMB
  - J. Scott Exercise at JSC
- Location: enviHab
- Year 1 – planning, definition, approvals, pilot.
- Year 2 - Implementation
Study parameters:
• $\angle \text{tbd}^\circ$ Head Down Tilt (HDT) depending on results of Acute study
• Duration: Extended from Acute CO2 study to ~ 1 month
• CO$_2$ at 0.5% - 1.0% depending on duration and safety
• 2 compliance groups – high (females) and low
• Sodium levels similar to ISS (fixed/constrained)
• Exercise – resistive (or resistive AND aerobic like ISS)
• $N =$ ?

Assumptions:
• Studies completed before this campaign begins:
  • Acute CO2 at enviHab
  • Mechanical Countermeasures NRA14
  • J. Scott - Exercise
• Location: enviHab
• Year 1 – planning, definition, approvals, pilot.
• Year 2 - Implementation
Study parameters:
• CO₂ (fixed)
• Tilt (fixed)
• Sodium similar to ISS (fixed)

Countermeasures to be tested
• Mechanical device
• Exercise modalities
• Pharm (only if no mechanical CM has proven effective)

Assumptions:
• Studies completed before this campaign begins:
  • Acute & Chronic CO2 at enviHab
  • Mechanical Countermeasures NRA14
  • J. Scott – Exercise
• Location: enviHab