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: ∠6°, 12°, 18° + eye changes; ∠12° w/ 1% CO2; ∠12° + 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 ∠6°
  - VIIP prefers to add 2 compliance groups and longer duration
- Scott: Effects of exercise modalities at ∠15°
- NSBRI Pilot – Confirms facility capabilities for CO2 administration, etc. Defines tilt ∠.
  - VIIP prefers to do multiple tilts ∠6°, 9°, 12° with 2 compliance groups (unless another study identifies optimum angle e.g. 9 degrees)
Expected study parameters:
• 24 hours at $\angle 6^\circ$ Head Down Tilt (HDT)
• $\text{CO}_2$ 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
Chronic CO₂

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Study parameters:
- ∠ tbd° Head Down Tilt (HDT) depending on results of Acute study
- Duration: Extended from Acute CO₂ study to ~ 1 month
- CO₂ 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
Countermeasures Validation

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