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:**

- $CO_2$
- 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
- **Visseri/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
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 V1IP related change)
- CO$_2$ 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 CO$_2$ study to $\sim$ 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 CO$_2$ at enviHab
  - Mechanical Countermeasures NRA14
  - J. Scott - Exercise
- Location: enviHab
- Year 1 – planning, definition, approvals, pilot.
- Year 2 - Implementation
Study parameters:
- CO$_2$ (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