DeltaT: Addressing Patient Harm From Peripheral Stimulation in Neurologic Exams

Team: Iralde Sicilia, Natasha Porwal, Kyle Cooper, Vaishnavi Pinni, Dennis Ngo, Grace Qin, Jeewoo Yoon, Tanish Madan

TA: Noah Lu | **Faculty Mentor:** Dr. Constanza Miranda | **Clinical Mentors:** Dr. Adam Schiavi and Dr. Geoffrey Miller

JOHNS HOPKINS BIOMEDICAL ENGINEERING

Background

In clinical practice, it is integral to measure consciousness in order to determine a patient's treatment and prognosis. In the current protocol to assess patient consciousness, the clinician begins with verbal cues such as calling the patient's name. If the patient does not respond, the physician moves on to using noxious stimuli with increasing levels of discomfort (a sternal rub, applying nail bed pressure, pinching the extremities, etc.) to trigger involuntary motor responses or reflexes (Jain & Iverson, 2023). Because these tests can be executed up to every hour, and patients can stay in the ICU for up to weeks at a time, the repeated stimuli often causes damage to the skin.

These injuries often distress the loved ones of patients, damaging their perception of provider care.

User Needs →	Design Requirements
Adjustable Stimulus Intensity	The device must have controllable intensity settings for the stimulus
Minimal Training Required	Designs must be ergonomic and intuitive for users
Available on Demand	The stimulus must be produced at the convenience of the user
Disposable Patient Interface	Solutions must be compatible with disposable covers for easy sterilization
Non-threatening Appearance	Designs must be visually pleasing to avoid distressing patient's loved ones

References

[1]Jain, S., & Iverson, L. M. (2023, June 12). Glasgow Coma Scale. Nih.gov; StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK513298/#:~:text=The%20Glasgow%20Coma%20Scale%20(GCS,%2C%20motor%2C%20and%20verbal%20responses.

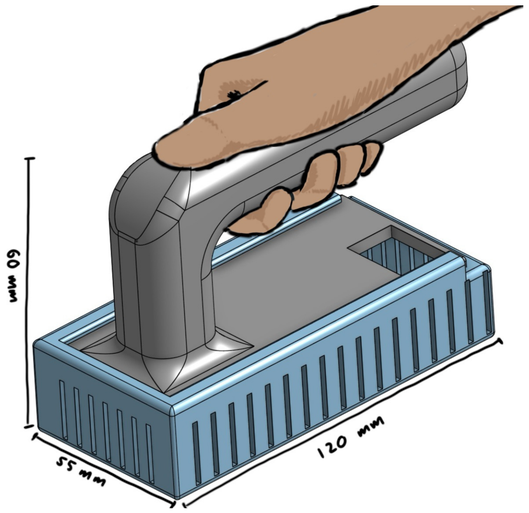
[2] Hourly neurologic assessments for traumatic brain injury in the ICU. (2014). Neurological Research. https://www.tandfonline.com/doi/full/10.1179/1743132813Y.0000000285

[3] Image taken by clinical sponsor

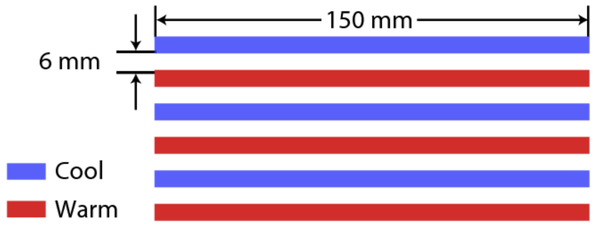
Solution

THE NEED: Healthcare providers in the Neuro-ICU need a method of assessing consciousness levels of patients without causing Local Skin Response 1 (LSR 1)*

*LSR 1 indicates any level of skin irritation (Hourly Neurologic Assessments for Traumatic Brain Injury in the ICU, 2014)



Thermal Grill Illusion (TGI):



20°C

ideal temperature gradient, with hot and cold apparatus at 40°C and 20°C.

Implementation

Current Workflow

Patient is diagnosed with a disorder of consciousness

↓

Clinician assesses patient's current level of consciousness through painful peripheral nerve stimulation

↓

These assessments occur as frequently as every single hour for weeks at a time

↓

The clinician repeatedly pinches the patient's extremities, causing large bruises to form

↓

Clinicans are unsure about exact level of consiousness as different clinicans obtain different results.

Consequences

- **Loss of trust between patient's loved ones and healthcare providers**
- **Visible bruising and skin damage**
- **Longer hospital stays**

Our Solution Benefits

- **Standardized method of measuring the consciousness levels of patients**
- **Improved relationship between clinicians in the Neuro-ICU and the loved ones of the patients**
- **Patients experience less surface level injuries (LSR) which leads to less potential complications**