NEUROSENTIS • OBJECTIVE NEUROLOGIC MONITORING

Feasibility of an Automated Glasgow Coma Scale (aGCS) Tool for Continuous Neurologic Monitoring

A non-invasive bedside "Brain Vital Sign" that automates and standardizes GCS assessment

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1 The Clinical Problem

The brain is the only vital organ system without an objective, continuous, non-invasive method for bedside physiologic monitoring.

- Neurologic status is tracked by **manual GCS exams every 1–4 hours** — subjective, labor-intensive, and burdened by high **inter-rater variability**.
- Frequent exams are hardest to sustain exactly where risk is highest: **ED boarding**, ED→ICU transitions, non-neuro ICUs, and periods of staffing strain.
- Delayed or missed deterioration → unrecognized **hematoma expansion**, progressive **cerebral edema**, delayed intervention, unnecessary repeat imaging, longer ICU stay, and worse outcomes.
- Most impacted: ED-boarding and ICU patients with altered mental status — TBI, ICH, SAH, post-arrest, ischemic stroke, hydrocephalus, and post-op neurosurgical patients.

Manual GCS vs. aGCS

MANUAL EXAM	AGCS
✕ Intermittent — every 1–4 h	✓ Continuous / on-demand
✕ Subjective, rater-dependent	✓ Objective & reproducible
✕ High inter-rater variability	✓ Standardized elicitation
✕ Manual charting, lag to record	✓ Auto-documented to EHR

2 The Solution

Neurosentis **operationalizes the bedside gold standard** rather than a surrogate signal — unlike EEG, ICP monitoring, or pupillometry.

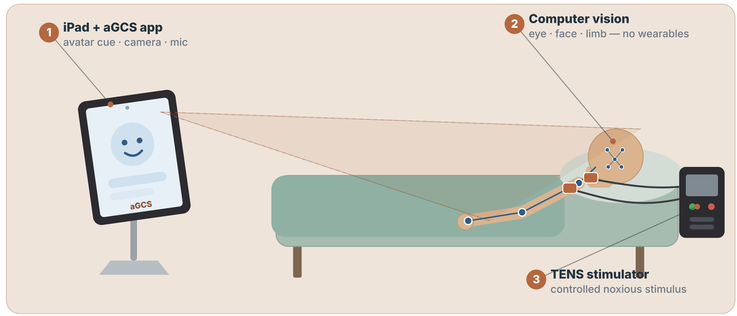
- Multimodal sensing, standardized stimuli, and proprietary algorithms elicit and score **Eye, Verbal, and Motor** responses in a structured, reproducible manner.
- Generates **real-time, automatically documented GCS** without a manual bedside exam — consistent, objective, and repeatable at a cadence manual assessment cannot match.
- Captures sub-categorical detail — **latency, asymmetry, and partial responses** — beyond the coarse 3–15 ordinal scale, enabling earlier detection of change.
- **Augments, not replaces,** clinician judgment: automated neuro-trending, reduced nursing burden, and standardized documentation built to fit existing ED/ICU workflows.

THE ADVANCE

Neurosentis converts an intermittent, subjective bedside exam into a continuous, objective, automatically documented Brain Vital Sign.

3 System & Methods

Inside the aGCS: iPad Vision + TENS



AUTOMATED PIPELINE

Figure 1. Bedside architecture — a single iPad running the aGCS app faces the patient: a talking avatar delivers standardized verbal commands while on-device computer vision scores eye, facial, and limb responses from video. A TENS stimulator delivers controlled noxious stimulation. Component E/V/M scores stream to real-time documentation.

- **Platform:** a bedside **iPad** runs the aGCS app — a talking avatar delivers standardized verbal commands while the front camera and microphone capture responses.
- **Motor & eye:** on-device **computer vision** tracks eye opening, facial motion, and limb/body movement directly from video — **no wearable sensors**.
- **Verbal:** on-device audio analysis captures and characterizes vocal responses to standardized prompts.
- **Stimulus:** a **TENS unit** delivers controlled, standardized noxious stimulation to elicit motor response when needed.
- **Output:** component-level E/V/M scores stream to time-stamped, structured documentation for **EHR integration**.
- **Study:** automated vs. clinician GCS under an **active IRB-approved feasibility study** at UChicago Medicine.

5 Impact & Value

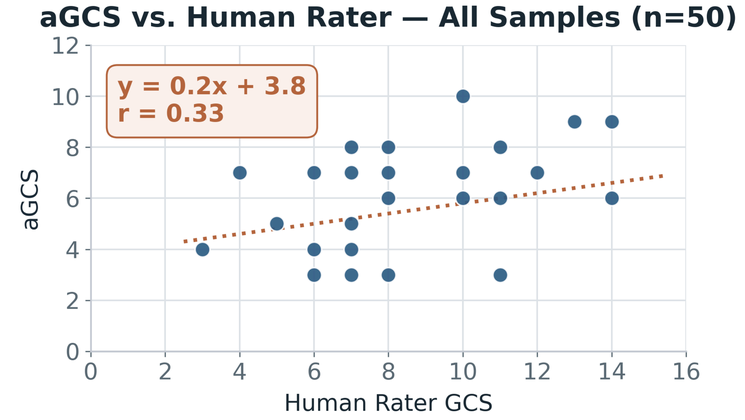
- **Settings:** Emergency Departments, Neuro-ICUs, and Trauma ICUs — targeting safety gaps during **ED boarding** and ED→ICU transitions.
- **Reduced burden:** offloads repetitive manual exams and standardizes documentation, freeing bedside staff during periods of strain.
- **Earlier detection:** continuous, high-resolution E/V/M data may surface neurologic change masked by the coarse ordinal GCS.
- **Battlefield relevance:** objective, low-footprint neuro-triage and trending where neurologic specialist coverage is limited.

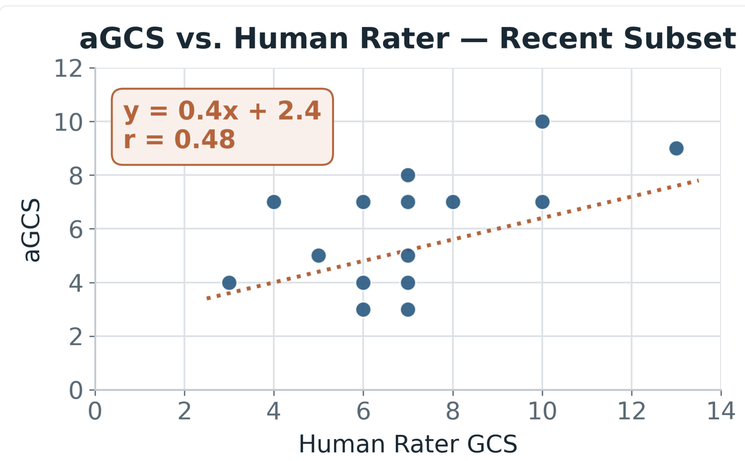
4 Preliminary Results

Fifty samples were collected — four healthy volunteers cycling through predefined GCS stages plus two ICU patients — comparing a neuro-ICU specialist (human rater) with the aGCS prototype.

r = 0.33
All samples (n = 50)

r = 0.48
Recent subset, post-modification





Correlation is modest but **improves with iteration**, demonstrating the technical feasibility of automated elicitation and scoring of neurologic responses **without continuous clinician presence**.

6 Development Status & Roadmap

● TRL-3 functional prototype — built from off-the-shelf components

- **Now:** active IRB-approved clinical validation at UChicago Medicine assessing accuracy, repeatability, and correlation with clinician-performed GCS.
- **Next:** algorithm refinement and expanded, higher-acuity patient cohorts to strengthen agreement.
- **Then:** real-time deterioration alerts and structured, time-stamped EHR integration for continuous neuro-trending.

LEARNING OBJECTIVES

1. Describe the hardware and software components of the aGCS system, including iPad-based computer vision and TENS stimulation.
2. Analyze limitations of manual GCS — inter-rater variability — and how automated trending may improve patient safety.
3. Discuss preliminary results and the feasibility of automated multimodal sensing to detect early neurologic deterioration.

DISCLAIMER

The aGCS is intended to **augment, not replace,** clinician ratings. It should not be used on patients with implanted electrical devices, known adhesive allergies, or during pregnancy. Preliminary data are based on a small sample (n = 50, including two patients). Final clinical validation is ongoing under an **active IRB-approved study at UChicago Medicine**.

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