# Serial Neuroimaging of Brain Growth and Development in Very Preterm Infants Receiving Tailored Neuropromotive Support in the NICU

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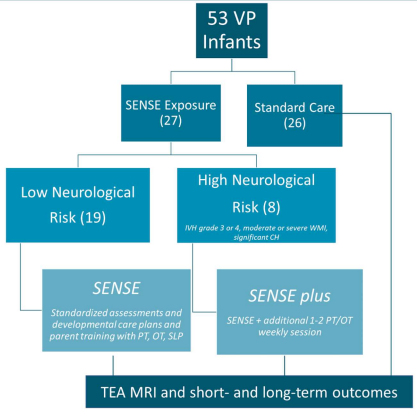
## Background

- Infants born very preterm (VP) undergo rapid brain development prior to term-equivalent age (TEA) while hospitalized in the NICU during a sensitive period[1]
- The Supporting and Enhancing NICU Sensory Experiences (SENSE) program is a multisensory-based intervention with weekly developmental support plans intended to be implemented by parents, with support from specialized staff[2]
- Early MRI imaging (at 30-34w GA) has the potential to identify infants with neurological injury and could help tailor early interventions for hospitalized preterm infants before TEA.

## Methods

- Prospective cohort study of 53 VP infants born < 33 weeks gestational age (GA)[3]
- Infants in the Exposed group were stratified into low- and high-risk based on neurological injury noted on early MRI and compared with a Standard Care (Nonexposed) group (Figure 1). Infants in the low-risk group received the study exposure i.e. SENSE program. High-risk infants received SENSE exposure and additional motor therapy (SENSE+) - Figure 1
- Serial MRIs were obtained at three times until TEA, along with routine cranial ultrasound (CUS) per unit guidelines.

### Figure 1: Study design




IVH, intraventricular hemorrhage; WMI, white matter Injury; CH, cerebellar hemorrhage; PT, Physical therapist; OT, occupational therapist; SLP, Speech and language pathologist

## Results

1) There were no differences between the perinatal, maternal sociodemographic, and infant clinical characteristics among the exposed (SENSE or SENSE+) vs non-exposed (SC) groups
2) Serial MRI imaging was feasible for all exposed participants, and informed risk stratification and tailoring neuropromotive therapy (SENSE or SENSE+) for VP infants
3) Early MRI identified more (n=11) high-risk infants, as opposed to CUS only (n=7) - Figure 2
4) More infants in the SENSE group (n=23, 85%) had TIMP scores in normal range at TEA compared with infants in SC (n=17, 65%), though this difference was not statistically significant. - Table 1
5) There were no differences between the HNNE or Kidokoro scores between the non-exposed and exposed groups at TEA (Table 1). Two-year neurodevelopmental data collection is underway.

### Figure 2: Cranial ultrasound versus early MRI findings



Figure 2A: Normal appearing cranial US of a 30-week GA newborn at 7 days of life

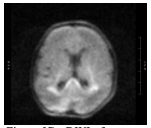


Figure 2B: DWI of same newborn DOL3, areas of acute WMI with restricted diffusion



Figure 2C: Normal appearing cranial US of a 31-week GA newborn at 4 days of life

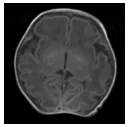
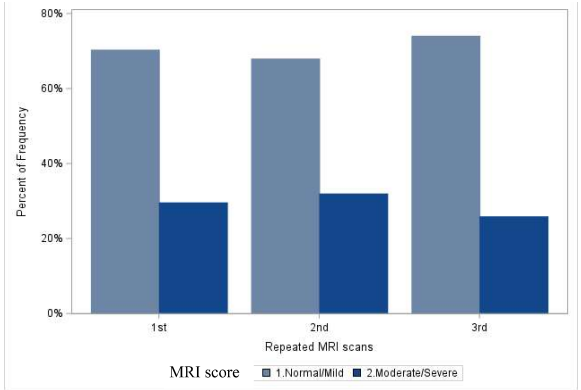


Figure 2D: Axial T1 image of same baby at day 15 showing area of gliosis in left parietal lobe

### Figure 3. Evolution of neurological injury of exposed infants from enrollment to TEA




### Table 1: Infant outcomes at TEA by exposure status (Exposed [SENSE or SENSE+] vs Nonexposed or Standard Care)

| | Total (n=53) | Non-exposed (n=26) | | Exposed (n=27) | | *p* |
|---|---|---|---|---|---|---|
| **Kidokoro_Score** | | | | | | 0.89 |
| Mean±SD | 6.2±4.9 | 6.4±5.7 | | 5.9±4.0 | | |
| | | LR | HR | LR | HR | |
| | | 3.9±2.2 | 11.1±7.4 | 4.2±2.6 | 9.9±4.1 | |
| **TIMP** | | | | | | 0.44 |
| Within average | 40 (75.5) | 17 (65.4) | | 23 (85.2) | | |
| | | LR | HR | LR | HR | |
| | | 11 (64.7) | 6 (66.7) | 17 (89.5) | 6 (75.0) | |
| Low average | 8 (15.1) | 5 (19.2) | | 3 (11.1) | | |
| | | LR | HR | LR | HR | |
| | | 2 (11.8) | 3 (33.3) | 2 (10.5) | 1 (12.5) | |
| Below average | 1 (1.9) | 0 (0.0) | | 1 (3.7) | | |
| | | LR | HR | LR | HR | |
| | | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (12.5) | |
| **HNNE** | | | | | | 0.40 |
| Mean±SD | 32.1±1.3 | 32.5±0.9 | | 32.0±1.4 | | |
| | | LR | HR | LR | HR | |
| | | 32.6±0.9 | 32.0±1.4 | 32.1±1.5 | 31.8±1.2 | |

## Conclusions

- Serial MRI brain imaging before TEA is feasible in hospitalized VP infants
- Early neuroimaging utilizing MRI accurately detects and classifies injury noted at TEA
- Early MRI identified more high-risk infants compared with CUS, and can be utilized to tailor neuropromotive care in the NICU during a sensitive period of brain development prior to TEA
- Results show that early and serial brain MRI offers valuable information for detecting and classifying brain injury in the preterm population.

## References

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2. Pineda, Smith, J., Roussin, J., Wallendorf, M., Kellner, P., & Colditz, G.. Randomized clinical trial investigating the effect of consistent, developmentally-appropriate, and evidence-based multisensory exposures in the NICU. Journal of Perinatology, 2021 41(10), 2449–2462.
3. Erdei C, Cherkerzian S, Pineda R, Inder TE. Serial neuroimaging of brain growth and development in very preterm infants receiving tailored neuropromotive support in the NICU. Protocol for a prospective cohort study. Front Pediatr. 2023 Oct 12;11:1203579.