

# Improved access to rapid electroencephalography at a community hospital reduces inter-hospital transfers for suspected non-convulsive seizures

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# Improved Access to Rapid Electroencephalography at a Community Hospital Reduces Inter-Hospital Transfers for Suspected Non-Convulsive Seizures

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|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BACKGROUND  | <ul style="list-style-type: none"><li>Delays in EEG acquisition and interpretation force providers to manage patients with suspected non-convulsive seizures empirically without EEG data or transfer for EEG monitoring.</li><li>Building conventional EEG capability in community hospitals is resource-intensive and does not address the delays inherent in conventional EEG infrastructure.</li><li>Novel point-of-care EEG devices could expand rapid access to EEG monitoring, expedite management of non-convulsive seizures, and reduce unnecessary transfers.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| AIMS        | <ul style="list-style-type: none"><li>Describe the impact of rapid access to EEG using a novel, point-of-care EEG device (Rapid-EEG) with remote interpretation (tele-EEG) on rate of inter-hospital transfer for long-term EEG monitoring.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| STUDY SITES | <ul style="list-style-type: none"><li>Stanford Health Care (SHC) operates an academic medical center, Stanford University Hospital (SUH), and an affiliated community hospital, SHC ValleyCare.</li><li>SUH has 24/7 access to conventional EEG monitoring and interpretation by EEG-trained neurologists.</li><li>Before the implementation of Rapid-EEG, SHC ValleyCare had access to conventional EEG only for routine studies during typical business hours and EEGs were interpreted by the local on-call neurologists without dedicated fellowship training in EEG.</li><li>After the implementation of Rapid-EEG, SHC ValleyCare acquired 24/7 access to EEG monitoring in addition to routine conventional EEG during business hours, and later, EEG interpretation was provided remotely by EEG-trained neurologists at SUH (tele-EEG).</li><li>This established a <i>hub-and-spoke model</i> for on-site EEG acquisition at the community “spoke” hospital and tele-EEG interpretation at the academic “hub” hospital.</li></ul> |
| DESIGN      | <ul style="list-style-type: none"><li>Retrospective cohort study of patients who underwent Rapid-EEG monitoring as part of a new standard-of-care at a community hospital between December 2018 and March 2020.</li><li>Rapid-EEG findings were obtained from the EEG report generated by the neurologist who originally read the study (SHC ValleyCare neurologist before October 2019, SUH epileptologist after October 2019).</li><li>Potential transfers were identified according to historical practice patterns based on a stepwise model that considered the clinical indication for EEG monitoring (preceding clinical event, cardiac arrest, or unexplained encephalopathy), immediate availability of conventional EEG, and, if available, conventional EEG findings.</li></ul>                                                                                                                                                                                                                                                 |
| OUTCOME     | <ul style="list-style-type: none"><li>Number of patients transferred for long-term EEG monitoring compared to the number of patients identified as potential transfers.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

# Rapid Response EEG System



## EEG Review Modalities

### Reduced Montage EEG — on bedside device or remote cloud portal

- 98% sensitivity for seizures and 100% specificity for seizures and HEP  
*Gururangan K et al. Clin Neurophysiol Pract 2018;3:65.*
- 95% concordance and 93% intra-rater agreement with full montage EEG  
*Westover MB et al. Neurocrit Care 2020;33:479.*

### EEG Sonification — on bedside device only

- 98% sensitivity for seizures and 85% specificity for seizures and HEP  
*Parvizi J et al. Epilepsia 2018;59:877.*

### Clarity Seizure Burden Trend — on bedside device or remote cloud portal

- 100% sensitivity and 93% specificity for status epilepticus  
*Kamoussi B et al. Neurocrit Care 2021;34:908.*

## Validating Studies

### DECIDE Multicenter Clinical Trial — *Vespa PM et al. Crit Care Med 2020;48:1249*

- Site: ICUs in five academic hospitals
- Findings: Bedside review of Rapid-EEG waveforms and sonification changed diagnosis and treatment decisions in 40% and 20% of cases, respectively, and increased diagnostic accuracy and confidence

### Stanford University Pilot Study — *Hobbs K et al. Neurocrit Care 2018;29:302*

- Site: ICU in single academic hospital
- Findings: Rapid-EEG sonification changed treatment decisions in 40% of cases and resulted in a significant net reduction in unnecessary anti-seizure treatments

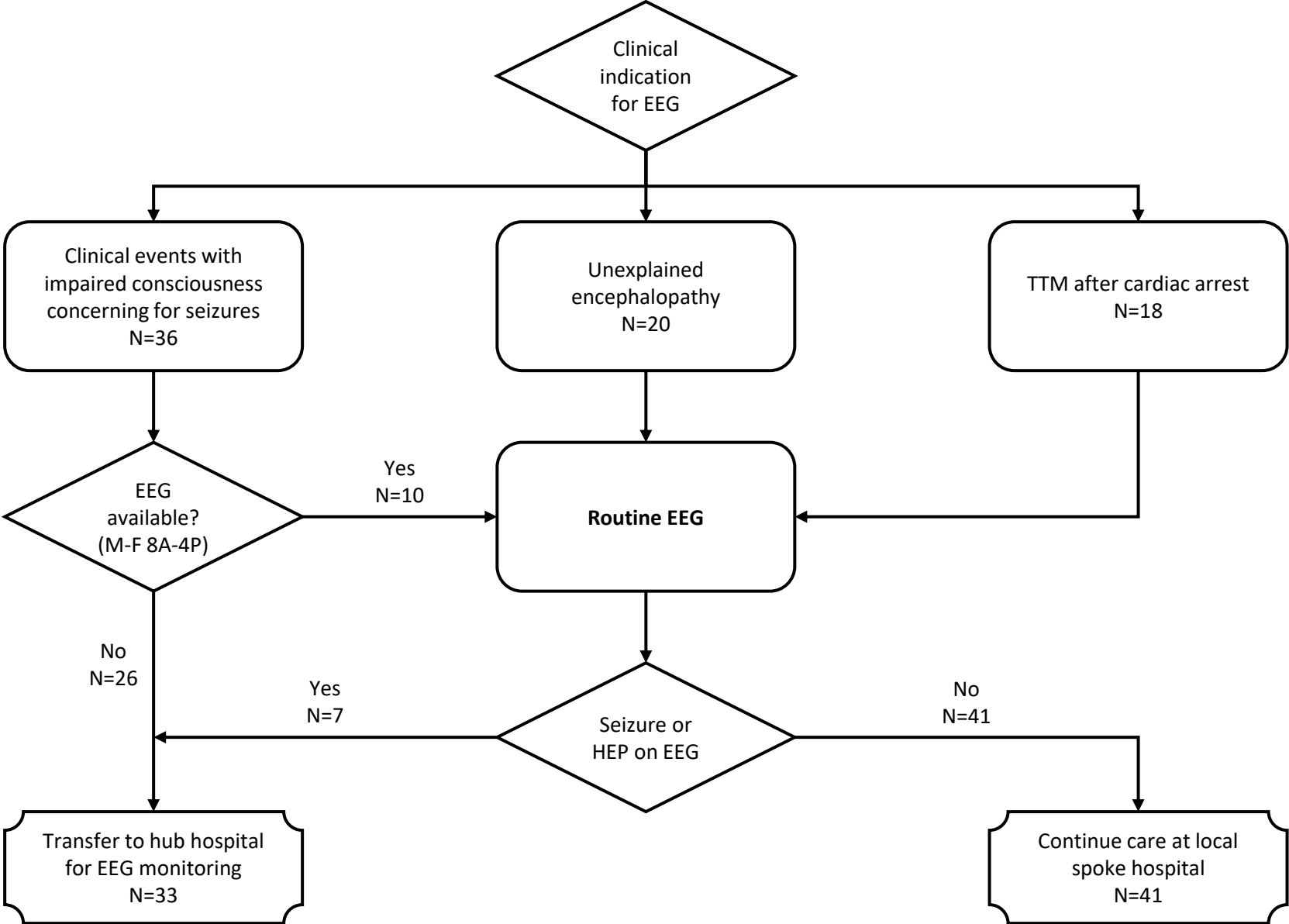
### John Muir Health Pilot Study — *Yazbeck M et al. J Neurosci Nurs 2019;51:308*

- Site: ICU in single community hospital
- Findings: Rapid-EEG sonification and waveform review ruled out status epilepticus and prevented overtreatment in 40% of cases

### Temple University and Stanford University Pilot Study — *Wright NMK et al. Emerg Med J 2021;38:923*

- Site: EDs in an academic hospital and a community hospital
- Findings: Rapid-EEG changed management in 53% of cases, primarily by ruling out seizures and preventing overtreatment, and expedited ED disposition in 21% of cases

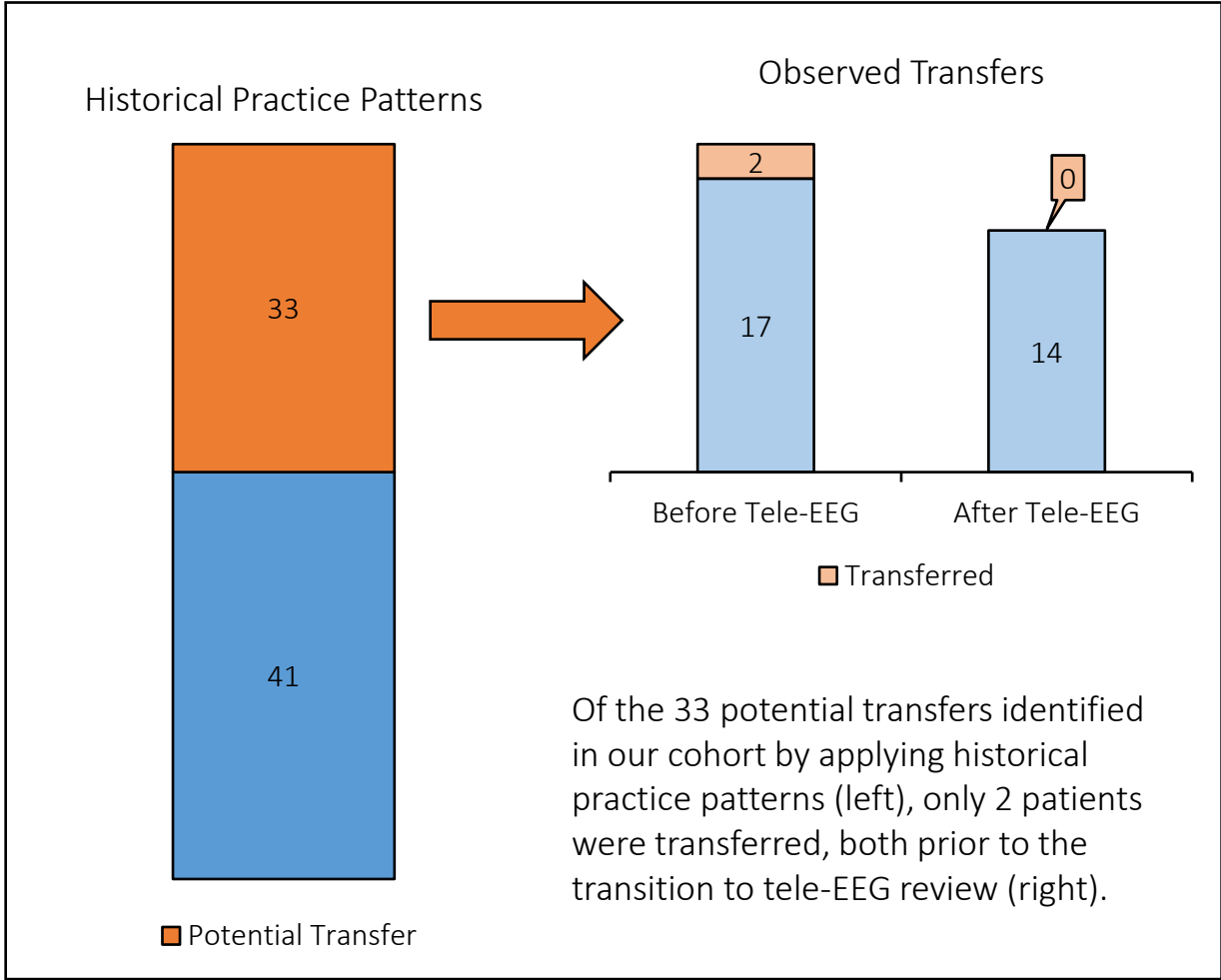
# Historical Practice Patterns



Thirty-three patients in our cohort would have been considered as potential transfers for long-term EEG monitoring if Rapid-EEG were unavailable.

The majority of these patients (26 out of 33) had clinical events with impaired consciousness concerning for seizures that occurred after-hours, when EEG was otherwise unavailable.

# Impact of Rapid-EEG and Tele-EEG on Rates of Inter-Hospital Transfer



|                                   | Patients Transferred (n/N) | Transfer Rate | ARR   | NNT |
|-----------------------------------|----------------------------|---------------|-------|-----|
| Before Rapid-EEG                  | 33/74                      | 44.6%         | —     | —   |
| After Rapid-EEG + Before Tele-EEG | 2/40                       | 5.0%          | 39.6% | 2.5 |
| After Rapid-EEG + After Tele-EEG  | 0/34                       | 0.0%          | 44.6% | 2.2 |

ARR = absolute risk reduction (historical rate minus observed rate); NNT = number needed to treat (inverse of ARR)

The integration of Rapid-EEG into clinical practice at a community hospital was associated with an 89% decrease in rates of observed completed transfers compared to estimated historical patterns (44.6% to 5.0%). Implementation of a hub-and-spoke tele-EEG model with remote Rapid-EEG review by expert epileptologists at the academic hospital further reduced the transfer rate; no patients were transferred during this later study period.

# Key Points

- Most community hospitals lack the EEG capacity to manage patients with non-convulsive seizures, necessitating transfer for EEG monitoring.
- Improving EEG access can guide treatment of patients with non-convulsive seizures and mitigate transfers solely for EEG monitoring.
- The majority of Rapid-EEG studies occurred after-hours, when EEG would have been unavailable and patients would have been transferred.
- Rapid-EEG monitoring with tele-EEG review prevented transfer for 94% of patients who would historically have been transferred.
- Novel EEG devices and tele-EEG review enabled the development of a hub-and-spoke model for managing patients with non-convulsive seizures.