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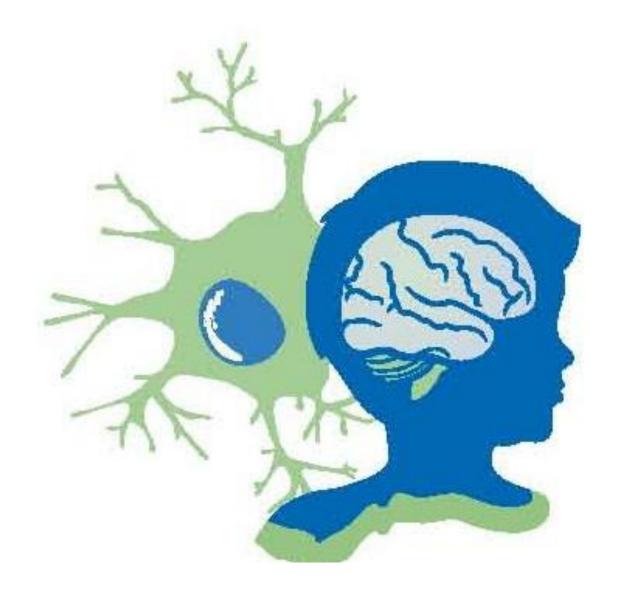


Accuracy of seizure identification by critical care providers using quantitative electroencephalography displays

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Introduction

- Non-convulsive seizures are common in the critically ill
- Detectable only by electroencephalography (EEG)
- Continuous EEG in ICU is interpreted intermittently
- Delays between seizure recognition & treatment
- Quantitative EEG (QEEG) can simplify interpretation
- Color Density Spectral Array (CDSA)

1. To evaluate the accuracy of CDSA and aEEG for

seizure detection in the hands of critical care providers

2. To identify the factors that influence the performance

- Amplitude-integrated EEG (aEEG)
- Limited data on utility of QEEG in the hands of critical care providers in pediatric ICU

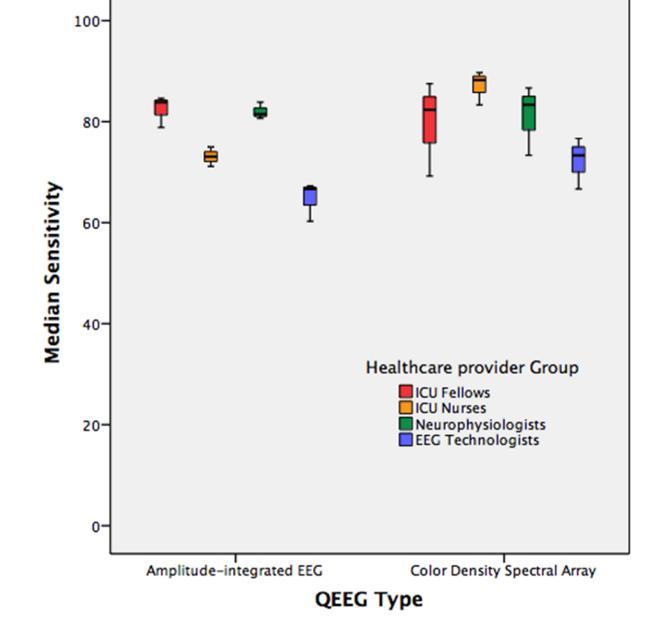
Methods

- Asked to mark all events suspected to be seizures
- No access to raw EEG or clinical data
- <u>Sensitivity</u>: Proportion of seizures marked compared to the gold standard review of raw EEG
- False positive rate: Number of events marked 'off' seizures per 24 hours of recording
- Performance across groups compared using mixed model, pairwise comparison and nested model analysis
- Mean square error attributable to different determinants of performance calculated

Results

- Critical care providers performed as well as neurophysiologists at seizure identification using both CDSA and aEEG (Table 1, Figure 2)
- 2. ICU Fellows and ICU nurses had similar performance:
 - . Median sensitivity ranged from 82.4%–88.2% for CDSA and 73.1%–83.8% for aEEG
 - ii. FPR ranged from 7.1–7.7 for CDSA and 2.8–4.2 falsely marked seizures per 24h for aEEG

Figure 2: Performance of CDSA and aEEG across groups



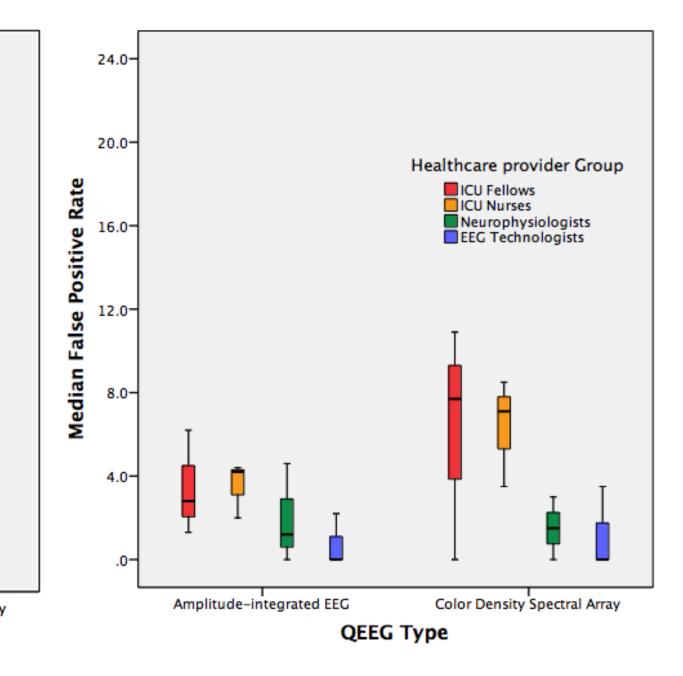


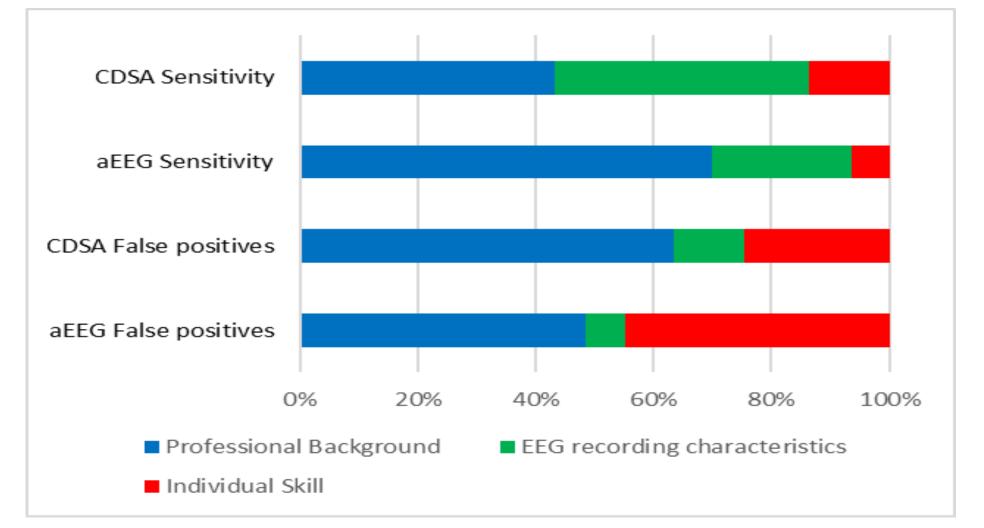
Table 1: Performance of CDSA and aEEG across groups

Group	CDSA, median (IQR*)		aEEG, median (IQR*)		
	Sensitivity (%)	FPR (per 24h)	Sensitivity (%)	FPR (per 24h)	
ICU Fellows	82.4 (75.8 – 84.9)	7.7 (3.9 – 9.3)	83.8 (81.3 – 84.2)	2.8 (2.1 – 4.5)	
ICU Nurses	88.2 (85.8 – 89)	7.1 (5.3 – 7.8)	73.1 (72.1 – 74.0)	4.2 (3.1 – 4.3)	
Neurophysiologists	83.3 (78.3- 85)	1.5 (0.8 – 2.3)	81.5 (81.1- 82.7)	1.2 (0.6- 2.9)	
EEG Technologists	73.3 (70.0 -75.0)	0 (0 - 1.8)	66.7 (63.5 – 67)	0 (0 -1.1)	
* IQR calculated by Tukey's Hinges method		FPR: False Positive Rate			

Results

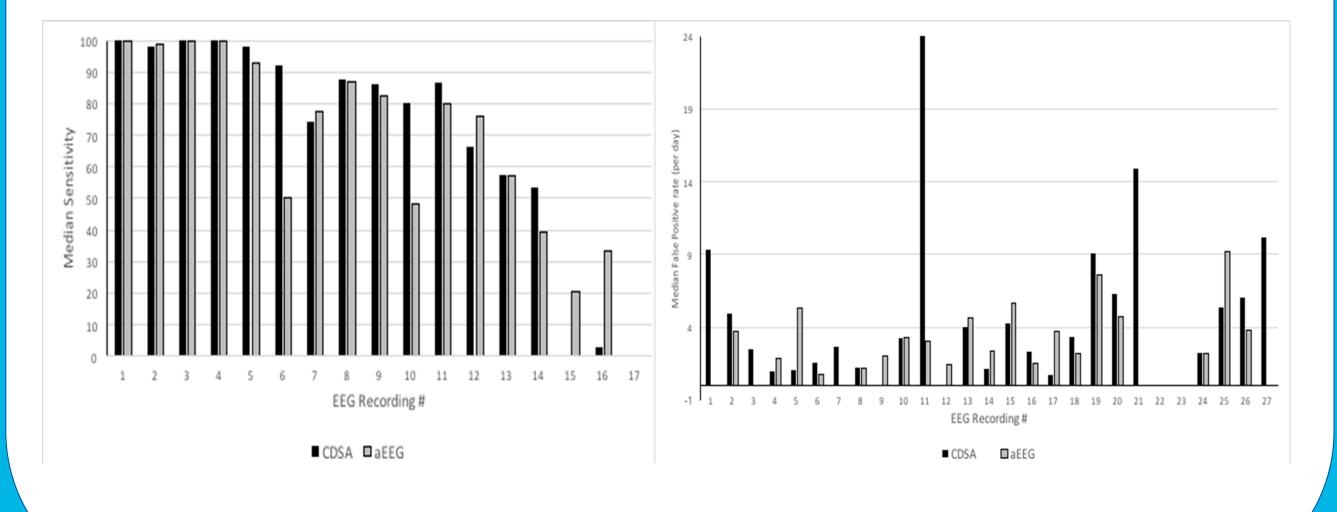
3. Across inter-professional groups, (Figure 3)
i. Sensitivity was more consistent using CDSA
ii.False positive rate was more consistent using aEEG

Figure 3: Determinants of performance for CDSA and aEEG



4. However, performance varied across individual EEG recordings for both CDSA and aEEG (Figure 4)

Figure 4: Sensitivity & false positive rates by EEG recordings



Conclusions

- 1. Critical care providers can identify seizures as well as neurophysiologists using CDSA & aEEG displays
- Our results confirm and extend previously published work in critically ill adults & children by Swisher et al., Dericioglu et al. and Topjian et al.
- 2. Both CDSA and aEEG have strengths & weaknesses
- 3. Some cEEG recordings present challenges irrespective of professional background
- 4. Although accuracy with CDSA & aEEG is not as good as raw EEG, use of these tools by critical care providers could result in more timely seizure detection
- 5. In clinical practice, suspected seizures identified by critical care providers should be confirmed by neurophysiologists



Methods

when using CDSA and aEEG

Objectives

- Participants: Three volunteers each from 4 groups:
 ICU Fellows, ICU Nurses, Neurophysiologists and EEG
 Technologists
- cEEG from critically ill children aged 1 month-18 years
- Gold standard: Seizures confirmed by review of the raw cEEG by a board-certified neurophysiologist
- Participants underwent 2h of formal QEEG training
- Performed supervised review of 27 cEEG recordings with only CDSA and aEEG displays visible (Figure 1)

Figure 1: Representative CDSA and aEEG displays

CDSA Fp1-C3	0.00Hz 286.2	VIII I DONA A TRANSPORTA COMMUNICATIONS	CFM Fp1-C3	53.13 \ 91.50	2JU UY		
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CDSA Fp2-T4	0.00Hz 15.2		200 I CFM Fp2-T4	37.36 \ 76.25	20UUV		
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CDSA T4-02	0.00Hz 93.9		200 CFM T4-02	26.95 \ 79.45	ANUV		
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00:27	13.00:26 15.00:26	17:00:26	19:00:26 11:00:27	13:00:26	15.00:26	17:00:26	

Stewart et al., Neurology 2010.