

BENEFITS OF LONG-TERM AMBULATORY VIDEO EEG; COST SAVINGS AND EFFICACY

Laura Tahri, R. EEG T.
Director of Clinical Services
Alliance Neurodiagnostics



Everyone here should be familiar with the reasons people get EEG's, but here is the short list:

1. Established history of seizures
2. New seizure-like events
3. Differential Diagnosis: Symptoms which could be seizures or something else
4. Suspicion of sub-clinical seizures or SE
5. Evaluation of Coma

We also know that each patients diagnostic journey starts with a routine EEG, 20 or 60 minutes in duration. When the short-term EEG does not capture the problem adequately or at all, the doctor will typically order a long-term EEG.



According to the Real-World Economic article:
“Although there is strong evidence that routine EEG with unequivocal epileptic activity can help establish an epilepsy diagnosis after the first seizure, the yield of that first EEG in identifying such activity is limited due to relatively low sensitivity of the test. The use of more than one EEG recording, longer monitoring time, and the use of video during long-term EEG significantly improve the diagnostic value of EEG.

Let’s understand the benefits of Ambulatory as well as the complimentary nature of Ambulatory and EMU.



Once upon a time, not so many years ago, Ambulatory was only ordered in absolute desperation to get a patient tested. Does anyone remember when we recorded to cassette tapes? That wasn't that long ago.....

Technological advances have fostered growth in this modality:

- DIGITAL
- Data storage
- HD Cameras
- Remote control capabilities

Ambulatory Video EEG is especially helpful for patients who need diagnostics, yet they are “non-emergent” patients.



- Those people who already have a diagnosis; seizures are generally well-controlled, and the patient just needs a follow-up EEG.
- Those people who are having symptoms which point to more than one potential cause.
- Those people who recently started having seizure-like events.
- Suspected nonepileptic events: PNES (Psychogenic Nonepileptic Seizures) or “Conversion Disorder”.



LOWER COST

“Even after controlling for baseline differences, the epilepsy-related cost of the index diagnostic event was significantly lower for the outpatient VEEG cohort (\$4,098) compared to the inpatient VEEG cohort (\$13,821).”

20% of \$13,821.00 is \$2764.00

20% of \$4000.00 is \$819.00

(typical Medicare co-pay)

On average, AVEEG costs 30% or more less than a hospital stay.

To learn more about the economics of inpatient and outpatient long-term VEEG, please visit the article:

<https://www.tandfonline.com/doi/full/10.1080/13696998.2019.1636382>



FASTER TO SCHEDULE/GET RESULTS

The patient's wait time to schedule is often merely 1 week or less, whereas it can take up to 3 months to gain access to the EMU.

According to the Real-World Economics article,

“Time from physician referral to index VEEG was significantly shorter in the outpatient cohort (30.6 vs. 42.5 days).”

“Given its burden, accurate and timely diagnosis of epilepsy is essential for providing appropriate disease management options and preventing significant negative, physiological, and socioeconomic consequences.”



MORE ACCESSIBLE

Not all ambulatory is set-up in the patient home, but these days most do. Sometimes this can mean driving 6 hours one-way; making it much easier for patients, especially in rural areas where there are no EMU options.

There are only 251 Epilepsy Centers currently accredited by the NAEC (National Association of Epilepsy Centers) across 47 states including Puerto Rico.

That is simply not enough to service the estimated 3.4 million people (1% of the entire population) with epilepsy and patients not yet properly diagnosed.



AT HOME

Ambulatory Video EEG is effective at capturing typical symptoms since the patient continues their normal routine as closely as possible. This includes normal stressors as well; normal stressors can be triggers for some symptoms.

Cumulative data shows that 70-75% of our patients capture at least one event during the typical 3-day recording. Capturing the typical symptoms is essential to diagnosis.

According to the Real-World Economics article: “Recent advances in technology allow a patient to undergo VEEG studies in the convenience of their home, and disease-area experts suggest that the cost may be considerably lower without compromising diagnostic accuracy.”

Plus, it’s just nice to be home instead of at the hospital if you don’t need to be there 😊



According to the article:

“Of 9221 AVEM recordings performed across 28 states, 62.5% attained primary outcome. At least one patient-activated pushbutton event was captured on video in 54% of AVEM recordings (53.6% in adults, 56.1% in children). Epileptiform activity was reported in 1657 (18.0%) AVEM recordings (1473 [88.9%] only interictal, 9 [0.5%] only ictal, 175 [10.6%] both interictal and ictal). Most common patient-reported symptomatology during AVEM pushbutton events was behavioral/autonomic/emotional in adults and children. Compared to AVEM, inpatient VEM captured more confirmed representative events in adult and pediatric samples.”

To read the 10,000 patient cohort article in Seizure Journal, please visit the article: [https://www.seizure-journal.com/article/S1059-1311\(18\)30780-5/fulltext](https://www.seizure-journal.com/article/S1059-1311(18)30780-5/fulltext)

VAEEG PHENOMENOLOGY

BY HISTORY n=9221

	n	%	OR	p-value	EPILEPTIFORM
SIMPLE SENSORY	1624	17.6%	0.77 - 1.01	0.094	16.5%
ALTERED SENSORIUM/AWARNESS	6150	66.7%	0.66 - 0.82	<0.001	16.4%
DYSCOGNITIVE	3322	36.0%	0.81 - 1.02	0.107	17.1%
LOA/LOC	3633	39.4%	0.95 - 1.19	0.267	18.5%
FOCAL MOTOR	1681	18.2%	1.07 - 1.40	0.003	20.5%
NEGATIVE MOTOR	578	6.3%	0.94 - 1.43	0.179	20.1%
GENERALIZED MOTOR	2835	30.8%	2.11 - 2.62	<0.001	27.3%

PHENOMENOLOGY

DURING VAEEG n=4110

	n	%	OR	p-value	EPILEPTIFORM
SIMPLE SENSORY	771	18.8%	0.79 - 1.19	0.794	17.4%
ALTERED SENSORIUM/AWARNESS	2250	54.7%	0.61 - 0.85	<0.001	15.6%
DYSCOGNITIVE	411	10.0%	0.77 - 1.30	1.000	17.8%
LOA/LOC	354	8.6%	1.24 - 2.07	<0.001	24.9%
FOCAL MOTOR	929	22.6%	0.89 - 1.30	0.464	18.6%
NEGATIVE MOTOR	155	3.8%	0.67 - 1.54	0.915	18.1%
GENERALIZED MOTOR	278	6.8%	1.76 - 3.00	<0.001	31.7%

PEDIATRIC VAEEG

VAEEG PHENOMENOLOGY BY HISTORY n=706					
	n	%	OR	p-value	EPILEPTIFORM
SIMPLE SENSORY	66	9.4%	0.36 - 1.13	0.135	25.8%
ALTERED SENSORIUM/AWARNESS	378	53.5%	0.54 - 1.00	0.057	31.2%
DYSCOGNITIVE	159	22.5%	0.67 - 1.41	0.925	34.0%
LOA/LOC	330	46.7%	0.64 - 1.19	0.384	32.7%
FOCAL MOTOR	177	25.1%	1.04 - 2.10	0.029	41.2%
NEGATIVE MOTOR	43	6.1%	0.67 - 2.38	0.509	39.5%
GENERALIZED MOTOR	278	39.4%	1.24 - 2.33	0.001	41.7%
PHENOMENOLOGY DURING VAEEG n=319			NO DESCRIPTION = 247 (43.6%)		
	n	%	OR	p-value	EPILEPTIFORM
SIMPLE SENSORY	26	8.2%	0.15 - 1.15	0.090	19.2%
ALTERED SENSORIUM/AWARNESS	126	39.4%	0.37 - 0.97	0.041	27.8%
DYSCOGNITIVE	17	5.3%	0.65 - 4.61	0.300	47.1%
LOA/LOC	54	16.9%	0.68 - 2.27	0.531	38.9%
FOCAL MOTOR	81	25.3%	1.04 - 2.93	0.042	44.4%
NEGATIVE MOTOR	14	4.4%	0.49 - 4.25	0.570	42.9%
GENERALIZED MOTOR	32	10.0%	1.12 - 4.89	0.030	53.1%

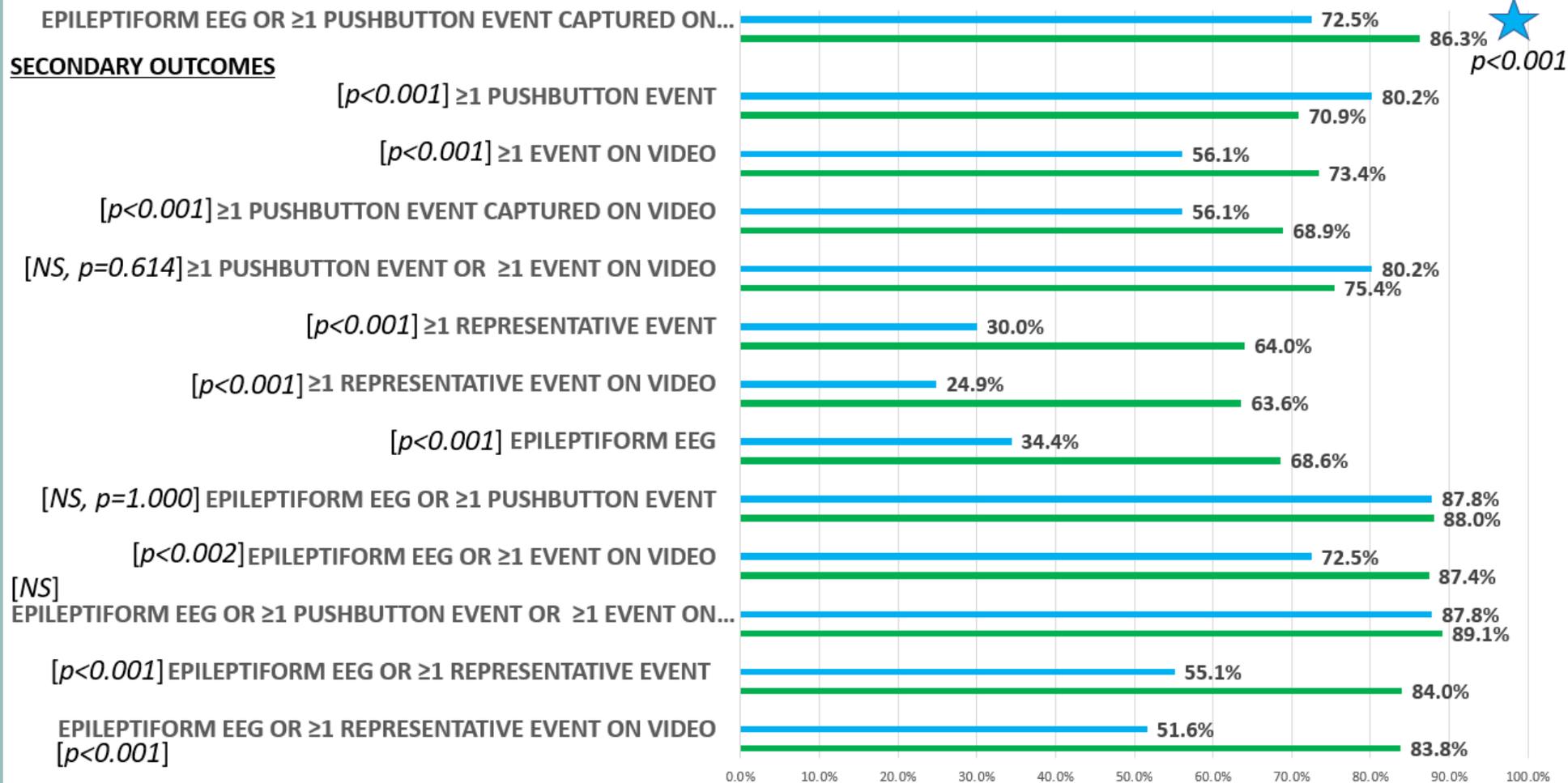
ADULT VAEEG

VAEEG PHENOMENOLOGY BY HISTORY n=8515					
	n	%	OR	p-value	EPILEPTIFORM
SIMPLE SENSORY	1558	18.3%	0.82 - 1.11	0.572	16.1%
ALTERED SENSORIUM/AWARNESS	5772	67.8%	0.69 - 0.88	<0.001	15.5%
DYSCOGNITIVE	3163	37.2%	0.85 - 1.08	0.507	16.3%
LOA/LOC	3303	38.8%	0.94 - 1.19	0.324	17.1%
FOCAL MOTOR	1504	17.7%	0.98 - 1.31	0.093	18.1%
NEGATIVE MOTOR	535	6.3%	0.92 - 1.44	0.230	18.5%
GENERALIZED MOTOR	2557	30.0%	2.12 - 2.69	<0.001	25.8%
PHENOMENOLOGY DURING VAEEG n=3791					
NO DESCRIPTION = 2572 (40.4%)					
	n	%	OR	p-value	EPILEPTIFORM
SIMPLE SENSORY	745	19.7%	0.88 - 1.35	0.408	17.3%
ALTERED SENSORIUM/AWARNESS	2124	56.0%	0.66 - 0.93	0.006	14.9%
DYSCOGNITIVE	394	10.4%	0.76 - 1.34	0.943	16.5%
LOA/LOC	300	7.9%	1.15 - 2.04	0.006	22.3%
FOCAL MOTOR	848	22.4%	0.80 - 1.21	0.916	16.2%
NEGATIVE MOTOR	141	3.7%	0.59 - 1.50	0.908	15.6%
GENERALIZED MOTOR	246	6.5%	1.66 - 2.96	<0.001	28.9%

PRIMARY OUTCOME

OUTCOME: VAEEG VERSUS INPATIENT EEG-MONITORING (PEDIATRIC)

VAEEG
INPATIENT VEEG



OUTCOME: VAEEG VERSUS INPATIENT EEG-MONITORING (ADULT)

VAEEG
INPATIENT VEEG

PRIMARY OUTCOME

EPILEPTIFORM EEG OR ≥1 PUSHBUTTON EVENT CAPTURED ON VIDEO



SECONDARY OUTCOMES

[p<0.001] ≥1 PUSHBUTTON EVENT



[p<0.002] ≥1 EVENT ON VIDEO



[p<0.001] ≥1 PUSHBUTTON EVENT CAPTURED ON VIDEO



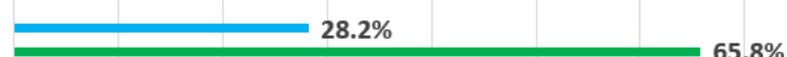
[NS, p=0.436] ≥1 PUSHBUTTON EVENT OR ≥1 EVENT ON VIDEO



[p<0.001] ≥1 REPRESENTATIVE EVENT



[p<0.001] ≥1 REPRESENTATIVE EVENT ON VIDEO



[p<0.001] EPILEPTIFORM EEG



[p<0.001] EPILEPTIFORM EEG OR ≥1 PUSHBUTTON EVENT



[p<0.002] EPILEPTIFORM EEG OR ≥1 EVENT ON VIDEO



[NS] EPILEPTIFORM EEG OR ≥1 PUSHBUTTON EVENT OR ≥1 EVENT ON...



[p<0.001] EPILEPTIFORM EEG OR ≥1 REPRESENTATIVE EVENT



[p<0.001] EPILEPTIFORM EEG OR ≥1 REPRESENTATIVE EVENT ON VIDEO



0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0% 90.0%

DISADVANTAGES

Delay in repair of electrodes or technical difficulties

- Most companies who monitor dispatch techs to fix problems as they occur, but this action is delayed compared to EMU

Cannot adjust medications to find best combination and/or therapeutic level

- This is NEVER within the scope of Ambulatory Patient may be off camera at times

- Part of the nature of ambulatory is allowing patients to follow their normal routine as much as possible, which sometimes takes them away from camera view



EPILEPSY MONITORING UNIT

EMU is more appropriate for patients who need a higher level of care:

- Titrating medications
- Inciting Seizures
- Stereo EEG/Brain Mapping
- PET, MEG, SPECT and WADA available
- DBS, VNS, RNS implants
- Depth Electrodes
- Nursing Care
- Neurologists direct involvement
- Neurosurgery



CONCLUSION

Ambulatory has been shown to be a cost-effective and accessible way for patients to receive the epilepsy diagnostic care they need and deserve.

If AVEEG is administered correctly, it can free up the Epilepsy Centers across America for patients who need that higher level of care for refractory Epilepsy.





Quote from Dr. William O. Tatum from the *Mayo Clinic*; Editorial from *Seizure* regarding the published paper by Dr. Tanvir Syed:

“In the end, recognizing aVEM (Ambulatory Video EEG Monitoring) as a vital complementary technique intermediate between standard EEG and video-EEG monitoring, performed by experienced interpreters to potentially circumvent high-cost, reduced access, facilitate diagnosis, and alleviate inconvenience associated with inpatient video-EEG monitoring, goes without saying.”

To read the entire editorial, follow this link:

[https://www.seizure-journal.com/article/S1059-1311\(18\)30780-5/fulltext](https://www.seizure-journal.com/article/S1059-1311(18)30780-5/fulltext)

Sources:

Outcome of ambulatory video-EEG monitoring in a ~10,000 patient nationwide cohort

Syed, Tanvir U. et al.

Seizure - European Journal of Epilepsy, Volume 66, 104 – 111

Jeremy D. Slater, Michael Eaddy, Conor M. Butts, Inna Meltser & Sharanya Murty (2019) The real-world economic impact of home-based video electroencephalography: the payer perspective, Journal of Medical Economics, DOI: [10.1080/13696998.2019.1636382](https://doi.org/10.1080/13696998.2019.1636382)