

Update on NAEAC Accreditation Data

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Background

- Partnership with NAEC to collect and analyze data from accreditation surveys
- Goals:
 - Characterize current practice
 - Analyze trends over time, future directions
 - Advance NAEC mission
 - Set standards of care
 - Advocate for access to high level care
 - Provide knowledge and resources to members



Data structure

- Data collection from:
 - Annual accreditation surveys
 - Recent set of supplemental surveys:
 - Epilepsy surgery practice
 - EMU practice and safety
 - Outpatient practice and future directions (coming soon)
- Supplemental surveys intended to:
 - Capture more granular center-level data
 - Gather expert opinion
 - Assess resource needs



2020 Annual Data

- 260 accredited centers, 100% annual report completion
- 2019-2020 data: Impact of COVID-19 epidemic





Impact of the COVID-19 Epidemic on Epilepsy Center Practice in the United States

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Background and Rationale

Persons with epilepsy, especially those with drug resistant epilepsy (DRE), may benefit from inpatient services such as admission to the epilepsy monitoring unit (EMU) and epilepsy surgery.

The COVID-19 pandemic caused reductions in these services within the U.S. during 2020.^{1,2,3}

This research highlights changes in resources, admissions and procedures among epilepsy centers accredited by the National Association of Epilepsy Centers (NAEC).

Methods

We compared data reported in 2019, prior to the COVID-19 pandemic, and 2020 from all 260 level 3 and level 4 NAEC accredited epilepsy centers.

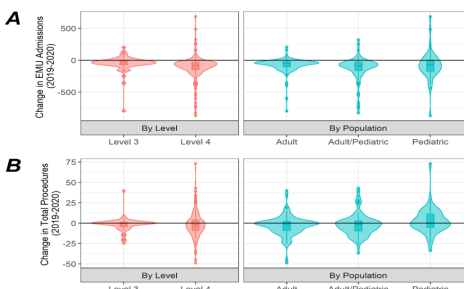
Data were described using frequency for categorical variables and median for continuous variables and were analyzed by center level, center population category and geographical location.

Qualitative responses from center directors to questions regarding the impact from COVID-19 were summarized utilizing thematic analysis. Responses from the NAEC center annual reports as well as a supplemental COVID-19 survey were included.

References

1. Winreb EC, Gotsman ZM, Knupp KG, et al. Care Delivery for Children With Epilepsy During the COVID-19 Pandemic: An International Survey of Clinicians. *J Child Neurol*. 2020;35:924-933.
 2. Cellase P, Rossetti AO, Genton P, Crespedi A, Kaplan PW. How to carry out and interpret EEG recordings in COVID-19 patients in ICU? *Clin Neurophysiol*. 2020;131:2029-2031.
 3. Zapata R, Lee Y, Agostini M, et al. Emergent Admissions to the Epilepsy Monitoring Unit in the Setting of COVID-19 Pandemic-related, State-mandated Restrictions: Clinical Decision-Making and Outcomes. *Neurologia*. 2021;31:99-103.

Results



Change in EMU admissions (A) and total procedures (B) displayed by NAEC center level or patient population. Violin plots by center level and overall box plots with median and IQR also show the smoothed density at different values. These plots include values of zero, as reported by the respondents.

Treatment	Level 3 Center			Level 4 Center		
	2019, N = 57 ^a	2020, N = 62 ^a	p-value ^b	2019, N = 197 ^a	2020, N = 196 ^a	p-value ^b
Temporal lobectomy	2.5 (2, 3.5)	1 (1, 2)	0.073	6 (3, 11)	5 (2, 9)	0.081
Extratemporal resection	1 (1, 1.2)	1 (1, 2.5)	0.5	4 (2, 8)	3.5 (2, 8)	0.7
Corpus callosotomy	2 (2, 2)	-	-	2 (1, 3)	2 (1, 4)	0.077
VNS implantation	5.5 (3, 10.2)	4 (2, 9)	0.4	9 (5, 16.5)	7 (4, 13)	0.011
Hemispherotomy	-	1 (1, 1)	-	2 (1, 4)	2 (1, 4)	0.3
Laser ablation	2 (2, 3)	2 (1, 2)	0.2	5 (2, 7.8)	4 (2, 8.2)	0.7
RNS implantation	1 (1, 2)	1 (1, 1)	>0.9	3 (1, 6)	4 (2, 6)	0.3
Intracranial electrodes, no resection	1 (1, 1)	1.5 (1.2, 1.8)	0.5	4.5 (2, 8)	5 (2, 8)	0.3
Total intracranial monitoring	1 (1, 2)	4 (2.5, 5)	0.3	8 (5, 17)	9 (5, 16)	>0.9
Total treatment surgery	6.5 (3, 12.5)	5 (3, 9)	0.4	25 (14, 47)	22 (11, 42)	0.15

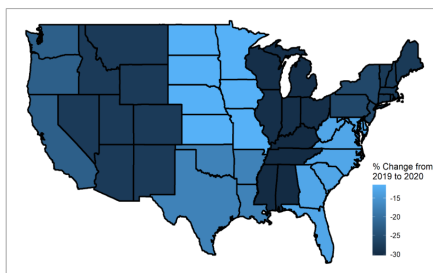
^aStatistics presented: median (IQR), among non-zero procedures

^bStatistical tests performed: Wilcoxon rank-sum test

Median procedure volumes by center level

EMU admissions declined 23% in 2020, with largest median reductions in level 3 centers (-44%) and adult centers (-39%).

Survey respondents attributed reduced admissions to re-assigning EMU beds, restrictions on elective admissions, reduced staffing and patient reluctance for elective admission.



Changes in aggregate admissions by U.S. census division from 2019 to 2020.

Aggregate treatment surgeries declined 5.7%, with the largest reduction occurring in VNS implantations (-19%) and temporal lobectomies (-16%). All other procedure volumes increased, including a 35% increase in corpus callosotomies.

Median surgery volumes did not significantly change across center type or demographic except for VNS implantations, which declined at level 4 and adult centers

2020 Annual Data

- EMU admissions declined (aggregate -23%)
 - Level 3 centers (-44%), adult centers (-39%), no decrease in pediatric centers
 - Median staffing, EMU beds and average LOS were unchanged



2020 Annual Data

Change in aggregate procedures by type:

Characteristic	Procedure Volume		% Change
	2019, N = 253 ¹	2020, N = 257 ¹	2019 to 2020
Temporal lobectomy	1,465	1,238	-15.5
Extratemporal resection	867	972	12.1
Corpus callosotomy	155	209	34.8
VNS implantation	2,622	2,136	-18.5
Hemispherotomy	190	205	7.9
Laser ablation	686	790	15.2
RNS implantation	561	625	11.4
Intracranial electrodes, no resection	1,010	1,098	8.7
Total intracranial monitoring	2,288	2,187	-4.4
Total treatment surgery	6,546	6,175	-5.7

¹Statistics presented: sum

Surgeries declined (-5.7%)

- VNS implantations (-19%)
- Temporal lobectomies (-16%)
- All other procedure volumes increased



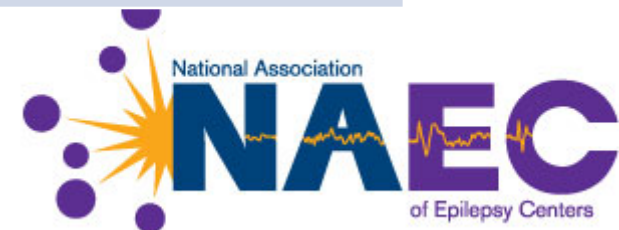
2020 Annual Data

Median procedure volumes by center demographic:

Characteristic	Adult			Adult/Pediatric			Pediatric		
	2019, N = 108 ¹	2020, N = 113 ¹	p- value ²	2019, N = 96 ¹	2020, N = 95 ¹	p- value ²	2019, N = 50 ¹	2020, N = 50 ¹	p- value ²
Temporal lobectomy	5 (2.8, 11)	4 (2, 8)	0.086	6.5 (3, 12)	4.5 (2, 8)	0.027	4.5 (2.2, 7.8)	6 (2, 10)	0.5
Extratemporal resection	3 (2, 5)	2 (1, 4.2)	0.2	4 (2, 8)	3 (1, 7)	0.5	7 (2, 11)	7.5 (4, 16)	0.3
Corpus callosotomy	2 (1, 2)	1 (1, 2)	0.5	1 (1, 3)	2.5 (1, 5.2)	0.093	2 (1, 4)	3 (1.5, 4)	0.2
VNS implantation	7 (4, 12)	5 (2, 8.2)	0.008	9.5 (5, 19.8)	8.5 (4, 13.2)	0.10	11 (5, 16.8)	10 (5.2, 17.5)	0.7
Hemispherotomy	1 (1, 2.5)	1 (1, 1)	0.4	2 (1, 2.8)	1 (1, 2.2)	0.6	2 (1.8, 5)	3 (1, 5)	0.8
Laser ablation	5.5 (4, 7)	4 (2, 8)	0.2	3 (2, 6)	4 (2, 7.8)	0.5	4 (3, 9)	4 (2.2, 8.5)	0.7
RNS implantation	4 (2, 7)	4 (2, 6)	0.8	3 (1, 6)	4 (2, 5.2)	0.2	2 (1, 3.8)	3 (1, 5)	0.2
Intracranial electrodes, no resection	5 (2, 8)	4 (2.5, 7.5)	0.6	4 (2, 8)	5 (2, 9.8)	0.3	4.5 (3, 6.8)	5 (3, 7)	0.7
Total intracranial monitoring	7 (3, 14.5)	8 (5, 15.5)	0.5	7.5 (4, 17.2)	7 (3, 16.5)	0.7	11 (4.5, 16)	12 (6.5, 17)	0.6
Total treatment surgery	17 (7.2, 30)	12 (5, 24)	0.044	22 (11, 40.8)	21 (10, 37.5)	0.5	32 (14.5, 49)	35 (18, 52.5)	0.8

¹Statistics presented: n (%); median (IQR), among non-zero procedures

²Statistical tests performed: chi-square test of independence; Wilcoxon rank-sum test; Fisher's exact test



Diagnostic Testing Data

- Annual survey data
- Supplemental Epilepsy Surgery survey data
- What epilepsy center characteristics influence testing for epilepsy surgery?



Diagnostic Testing Data

- Supplemental epilepsy surgery survey:
 - 206 adult epilepsy center directors and 136 pediatric epilepsy center directors
 - Directors reported percentage of patients receiving each test modality or consultation
- Data were collated with annual center data and U.S. Census region



Diagnostic Testing Data

Characteristic	Adult Combined, N = 95 ¹	Adult Only, N = 109 ¹	Pediatric Combined, N = 88 ¹	Pediatric Only, N = 50 ¹	p-value ²
LTM EEG for seizure capture at 100%	78 (82%)	94 (86%)	78 (89%)	43 (86%)	0.6
Brain MRI at 100%	76 (80%)	88 (81%)	75 (85%)	46 (92%)	0.2
FDG-PET	60 (25, 88)	60 (25, 90)	50 (14, 75)	70 (50, 90)	0.045
SPECT	10 (1, 23)	5 (0, 20)	8 (0, 25)	20 (5, 50)	0.005
HD EEG	0 (0, 4)	0 (0, 0)	0 (0, 5)	0 (0, 0)	0.090
MEG	5 (0, 10)	3 (0, 15)	8 (0, 26)	10 (0, 48)	0.094
fMRI	20 (5, 50)	20 (5, 70)	20 (5, 62)	50 (25, 68)	0.011
Wada	25 (10, 55)	15 (5, 40)	5 (0, 20)	1 (0, 5)	<0.001
ESI	0 (0, 15)	0 (0, 5)	0 (0, 11)	4 (0, 19)	0.044
Genetic testing	10 (5, 10)	5 (0, 10)	50 (25, 75)	70 (30, 80)	<0.001
TMS	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 1)	<0.001
Neuropsychological Testing	100 (90, 100)	95 (75, 100)	90 (50, 100)	90 (75, 100)	0.041
Social Work Evaluation	25 (10, 55)	30 (10, 80)	30 (10, 90)	72 (16, 100)	0.012
Psychiatry Evaluation	25 (10, 50)	25 (10, 50)	20 (10, 30)	15 (10, 30)	0.034
Psychology Evaluation	25 (15, 50)	20 (5, 50)	25 (10, 50)	22 (10, 58)	0.5

¹Statistics presented: n (%); median (IQR)

²Statistical tests performed: chi-square test of independence; Kruskal-Wallis test



Diagnostic Testing Data

Characteristic	Adult Combined, N = 95 ¹	Adult Only, N = 109 ¹	Pediatric Combined, N = 88 ¹	Pediatric Only, N = 50 ¹	p-value ²
FDG-PET	60 (25, 88)	60 (25, 90)	50 (14, 75)	70 (50, 90)	0.045
SPECT	10 (1, 23)	5 (0, 20)	8 (0, 25)	20 (5, 50)	0.005
fMRI	20 (5, 50)	20 (5, 70)	20 (5, 62)	50 (25, 68)	0.011
Genetic testing	10 (5, 10)	5 (0, 10)	50 (25, 75)	70 (30, 80)	<0.001
Neuropsychological Testing	100 (90, 100)	95 (75, 100)	90 (50, 100)	90 (75, 100)	0.041
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Diagnostic Testing Data

- Multivariate analysis
 - Multistep regression model
 - Associations between center characteristics and utilization
 - Potential model covariates: accreditation level, center and patient population demographics, institution type, geographic region...



Diagnostic Testing Data

Variable	Brain MRI	LTM EEG	Neuropsych testing	FDG PET	Social work	Psychology	Functional MRI	Psychiatry
Region, midwest	-	-	2.87 (1.20, 6.86)	2.74 (1.14, <u>6.61</u>)	5.60 (1.81, 17.29)	-	-	-
Region, northeast	-	-	1.59 (0.68, 3.73)	1.58 (0.66, <u>3.81</u>)	1.84 (0.61, <u>5.58</u>)	-	-	-
Region, west	-	-	0.99 (0.39, 2.50)	0.97 (0.37, <u>2.52</u>)	2.18 (0.63, <u>7.55</u>)	-	-	-

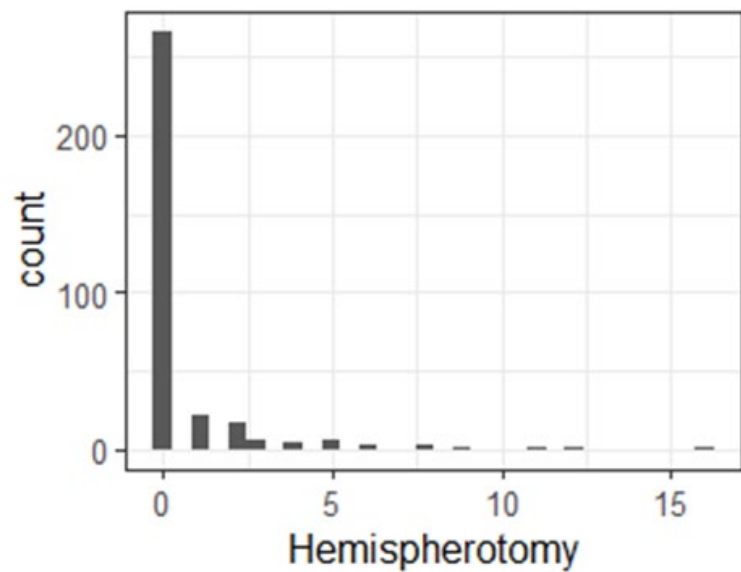
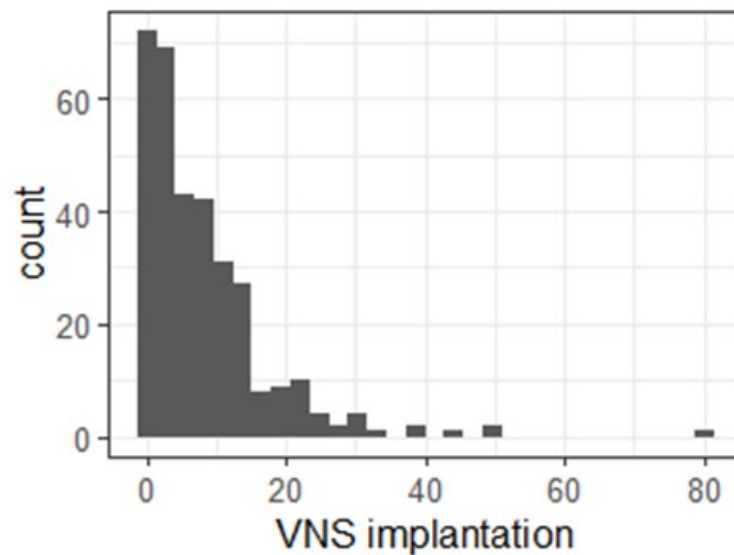
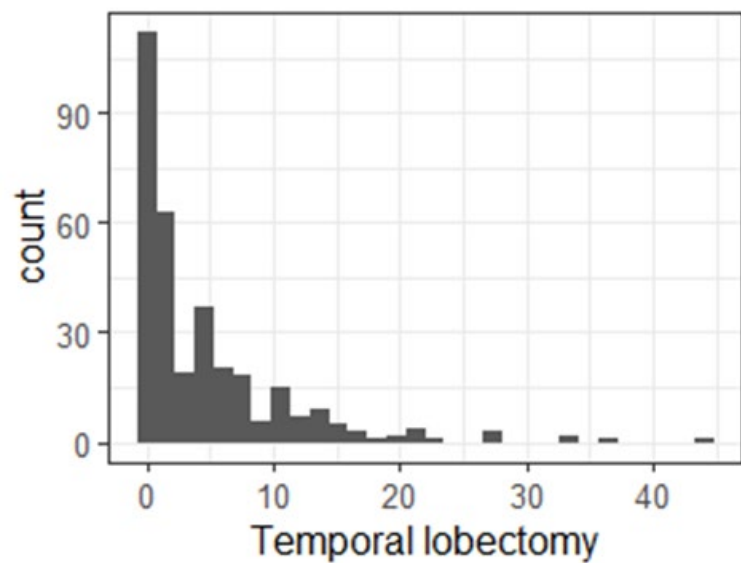
Variable	SPECT	Genetic testing	Wada	MEG	HD EEG	DSL	TMS
Region, midwest	0.83 (0.41, 1.68)	-	-	-	-	-	-
Region, northeast	0.46 (0.23, 0.93)	-	-	-	-	-	-
Region, west	0.41 (0.19, 0.87)	-	-	-	-	-	-

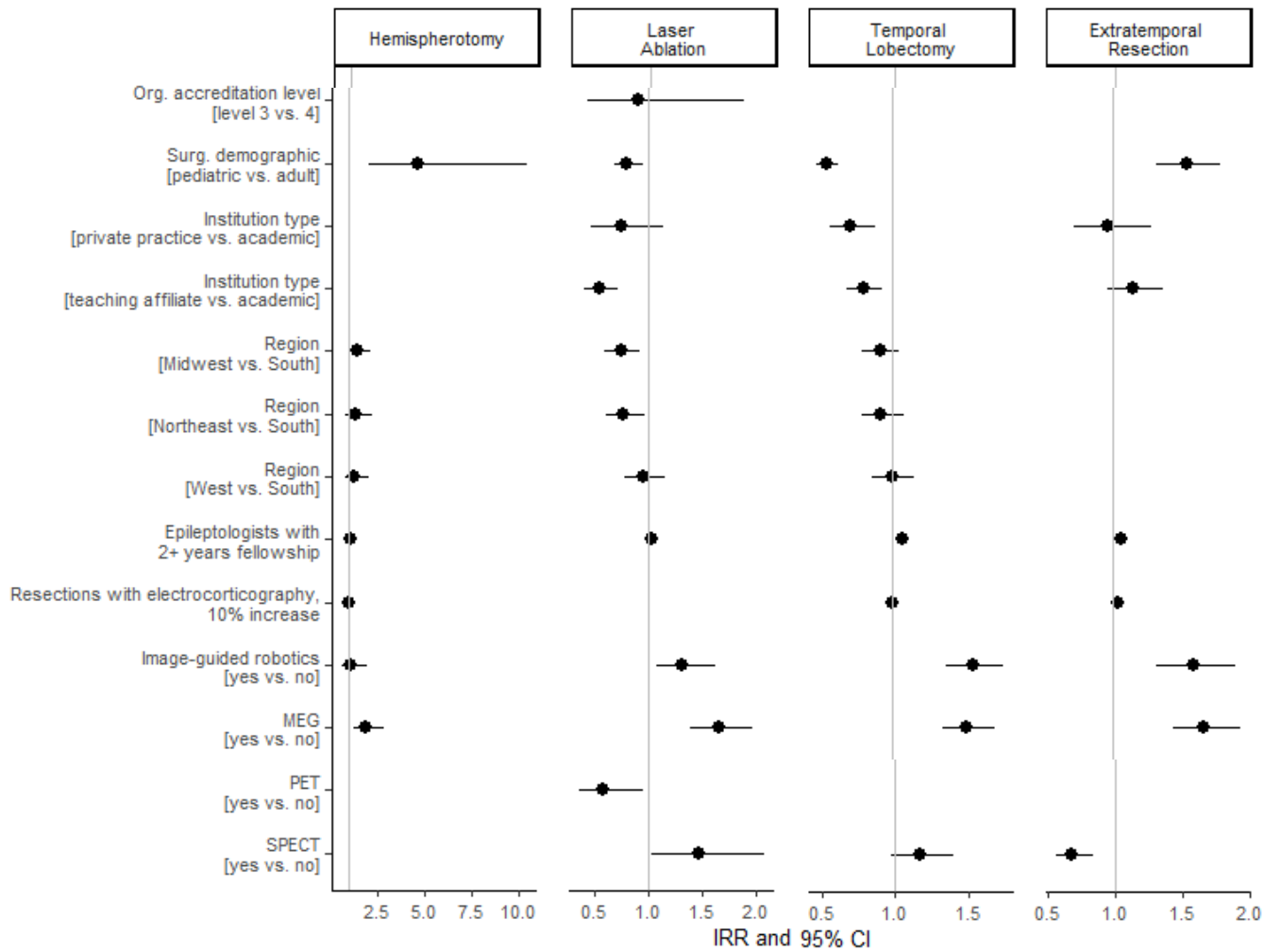


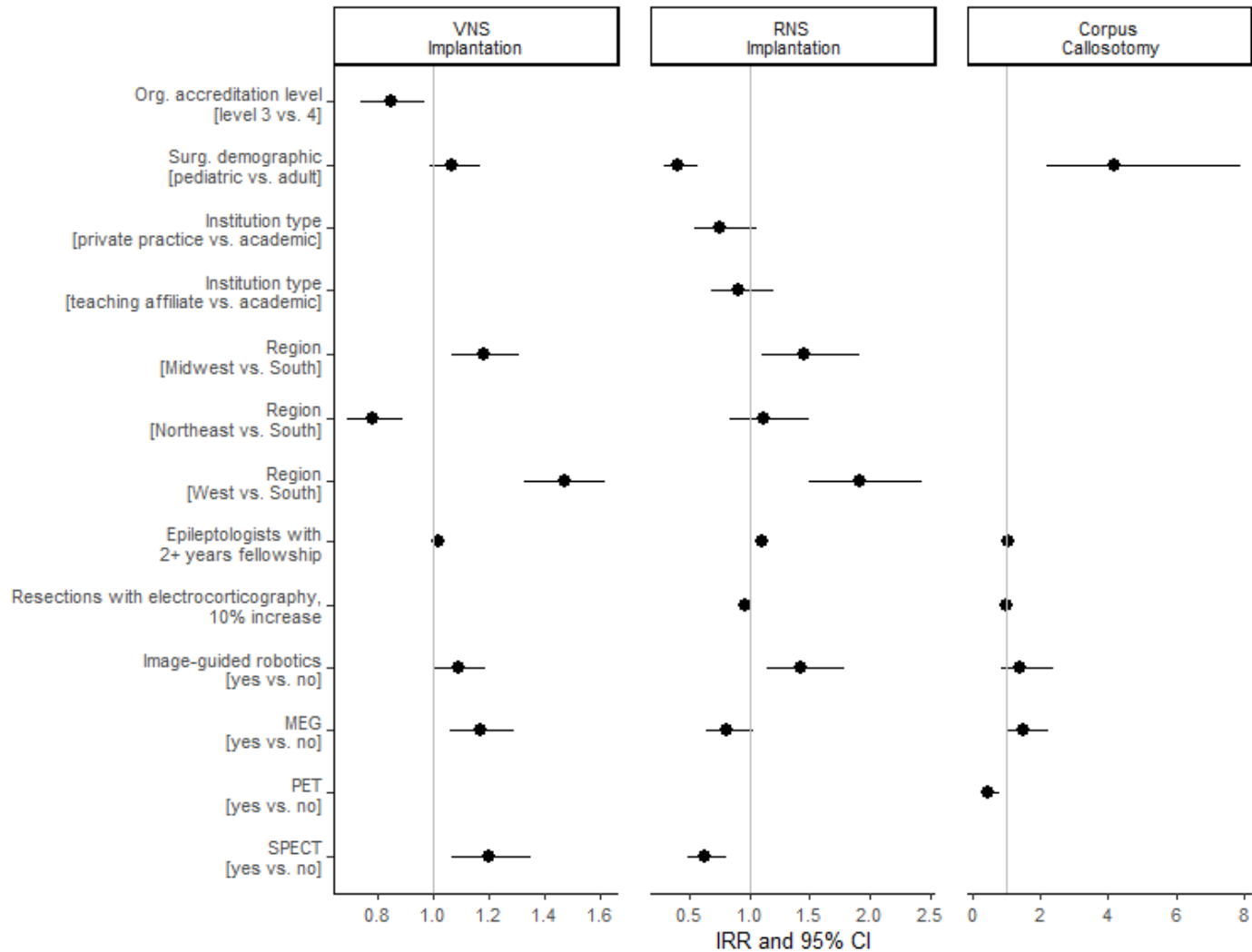
Treatment Data

- Analysis with zero-inflated Poisson model
 - What center characteristics increase the likelihood they do at least one procedure?
 - What center characteristics increase the likelihood they do each additional procedure?









Conclusions

- NAEC member center practices are changing
- Center characteristics influence testing and treatment
- Outcomes data are needed!

