Manuscript Title: Trends and Disparities in Deep Brain Stimulation Utilization in the United States: A Nationwide Inpatient Sample Analysis from 1993 to 2017

Supp. Table 1: ICD-9 and ICD-10 Codes Used in the Study

	ICD 9	ICD 10
Procedures		
Implantation or replacement of intracranial neurostimulator lead(s)	02.93	00H[00/03/04/60/63/64]MZ
Cranial implantation or replacement of neurostimulator pulse generator	01.20	0NH00NZ
Insertion or replacement of neurostimulator pulse generator	86.9[4/5/6/7/8], 86.09	0JH6[0/3][B/C/D/E/M]Z, 0JHT[0/3]YZ
Operations on thalamus and globus pallidus	01.4[1/2]	005[8/9][0/3/4]ZZ
Computer assisted procedure of head and neck region, with MRI	-	8E09XBH
Diagnosis codes used in DBS volume analysis		
Parkinson's Disease – paralysis agitans	332.0	G20
Essential tremor	333.1	G25.[0/2]
Dystonia	333.[6/7/79/82/83/89], 723.5	G24.[1/2/3/4/8/9]
OCD	300.3	F42.x
Other degenerative diseases of the basal ganglia	333.0	
Other involuntary movement disorders	333.[90/99], 334.1, 781.0	R25.[1/9]
Alzheimer's disease	331.0	
Dementia with Lewy bodies	331.82	G31.83
Huntington's & other choreas	333.[4/5]	G10, G25.5
Secondary parkinsonism	332.1	G21.[9/19]
Drug induced dystonia or dyskinesia	333.[72/85]	G24.0x
Multiple sclerosis and demyelinating diseases of CNS	340, 341.[8/9]	G35
Cerebrovascular disease	438.[11/20/21/22/30/53/81/89]	G46.3, I69.3[54/98]
Trigeminal neuralgia	350.[1/2/8/9], 053.12	G50.[0/1]
Cerebral palsy	343.[8/9], 333.71	G80.[0/3/9]
Chronic & central pain syndrome	338.[0/4/21/29]	G89.0
Major depressive disorder	296.[20/23/30/33/50], 311	F3[2/3].9
Tourette's disorder	307.2[0/3]	F95.2
Obesity	278.0[0/1]	
Headache & migraine	339.[02/22/89], 346.[20/21/80/91], 784.0	
Reflex sympathetic dystrophy	337.2[1/2/9]	
Dysthymic disorder	300.4	
Intermittent explosive disorder	312.34	
Tinnitus	388.30	
Hereditary sensory neuropathy	356.2	
Cerebellar ataxia	334.3	

Excluded seizure syndromes		
Epilepsy and recurrent seizures	345.x	G40.x
Neurofibromatosis	237.7x	Q85.[02/1]
Tuberous sclerosis and other hamartoses	759.[5/6]	R56.9
Convulsions	780.3x	
Temporal sclerosis	348.81	
Diagnosis codes for complications		
Infection	996.6[3/9], 998.59	T85.79XA
Disruption of operation (surgical) wound	998.[3/32]	
Mechanical complication	996.2	T85.[110/120/128/190/199]A
Other complications	996.[59/75/79], 997.01, 998.89	T85.890A
Diagnosis codes used in RF volume analysis		
Parkinson's disease – paralysis agitans	332.0	G20
Essential tremor	333.1	G25.0
Dystonia	333.[6/7/8x]	
Other movement disorders	331.89, 332.1, 333.[0/5/90], 340, 781.0	

CNS: Central Nervous System; DBS: Deep brain stimulation; ICD: International classification of diseases: MRI: Magnetic resonance imaging; OCD: Obsessive compulsive disorder; RF: Radiofrequency ablation.

"x" can be replaced by any number defined in ICD list.

Supp. Table 2: Volume of Surgeries by Indication and Year

DBS																										
Number of cases per year																										**Total**
Indication	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Parkinson's Disease	0	0	0	5	74	397	1197	1223	1374	1923	2511	2525	1873	1910	1770	1944	2233	2827	3388	2860	3610	3745	3885	3650	3750	**48674**
Essential tremor	0	0	0	5	66	655	699	387	624	317	506	696	484	564	428	485	968	844	1270	1090	1225	1385	1505	1505	1540	**17248**
Dystonia	0	0	0	0	0	11	20	37	20	32	116	124	74	141	106	278	120	248	306	165	175	170	185	280	195	**2803**
OCD	0	0	0	0	0	0	0	0	6	0	4	0	0	0	0	5	14	15	8	25	5	30	10	5	5	**132**
Other degenerative diseases of the basal ganglia	0	0	0	0	0	5	0	4	4	38	25	43	34	9	10	38	35	20	95	30	35	30	20	0	0	**475**
Other involuntary movement disorders	0	0	0	0	13	27	44	13	26	22	14	18	16	19	25	29	33	61	36	50	10	55	40	20	15	**586**
Alzheimer's disease	0	0	0	0	0	0	0	4	0	10	0	5	0	5	0	0	0	0	0	0	15	15	0	0	0	**54**
Dementia with Lewy bodies	0	0	0	0	0	0	0	0	0	0	0	14	4	22	19	14	9	0	17	30	25	10	10	10	5	**189**
Huntington's & other choreas	0	0	0	0	0	0	5	5	0	0	0	9	10	0	4	5	9	5	5	5	5	10	10	15	5	**107**
Secondary parkinsonism	0	0	0	0	0	10	0	0	0	9	0	0	0	4	5	0	9	5	4	0	5	5	10	15	10	**91**
Drug induced dystonia or dyskinesia	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	9	10	9	10	0	5	10	10	5	0	**73**
Multiple sclerosis	0	0	0	0	4	0	28	59	30	5	21	6	25	14	19	23	58	9	28	10	15	20	15	10	20	**419**
Cerebrovascular disease	0	0	0	0	0	0	14	5	0	0	11	21	19	66	32	5	27	5	9	20	10	5	5	15	15	**284**
Trigeminal neuralgia	0	0	0	0	0	15	0	10	10	5	63	8	20	48	19	5	26	31	25	35	10	5	15	10	20	**380**
Cerebral palsy	0	0	0	0	0	0	10	4	5	0	0	5	5	0	0	0	10	5	4	5	5	5	10	5	15	**93**
Chronic & central pain syndrome	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	24	20	5	22	20	20	15	15	15	15	**181**
Major depressive disorder	0	0	0	0	0	0	0	4	0	0	14	0	0	5	5	10	19	20	13	35	25	5	5	0	15	**175**
Tourette's disorder	0	0	0	0	0	0	0	0	0	0	0	0	35	18	5	10	17	24	9	10	15	20	0	0	20	**183**
Obesity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5	0	0	0	**10**
Headache & migraine	0	0	0	0	0	5	5	4	10	0	11	5	9	19	39	5	5	46	9	5	5	0	10	0	0	**192**
Reflex sympathetic dystrophy	0	0	0	0	0	7	5	5	5	0	5	0	0	0	0	0	5	10	0	5	0	5	0	0	0	**52**
Dysthymic disorder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	**5**
Intermittent explosive disorder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	**6**
Tinnitus	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	**5**
Hereditary sensory neuropathy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	**5**
Cerebellar ataxia	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**5**
Unrelated Indications	0	0	0	274	177	206	398	173	186	193	226	209	232	198	200	93	256	166	147	160	180	130	160	80	95	**4139**
Total	0	0	0	284	334	1338	2425	1942	2300	2554	3527	3688	2845	3047	2696	2984	3887	4356	5404	4575	5395	5675	5920	5645	5745	**76566**
Off-Label Indications (Total)	0	0	0	0	17	69	111	122	90	89	164	134	182	234	192	179	296	256	285	275	200	215	175	125	160	**3570**

Indication	

RF																									
Number of cases per year																									**Total**
Indication	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Parkinson's Disease	40	879	967	1575	1492	1159	1197	173	54	110	17	23	0	27	0	19	19	15	9	35	10	15	10	0	10	**7855**
Essential tremor	41	62	50	93	137	231	280	124	85	43	27	42	20	37	0	65	20	35	0	30	0	0	20	10	5	**1457**
Dystonia	4	19	11	20	33	33	30	24	11	37	22	9	0	0	0	0	0	0	0	5	0	5	0	0	0	**263**
Other movement disorders	5	16	20	42	26	27	58	25	4	9	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	**242**
Unrelated Indications	40	48	33	62	30	20	38	13	19	5	33	27	14	204	8	8	20	14	6	20	10	5	15	25	20	**737**
Total	130	1024	1081	1792	1718	1470	1603	359	173	204	99	101	34	268	8	92	64	69	15	90	20	25	45	35	35	**10554**

DBS: Deep brain stimulation; OCD: Obsessive-compulsive disorder; RF: Radiofrequency ablation

Off-label indications of DBS encompass any uses of the treatment that are not included among the FDA-approved indications, which include Parkinson's disease, essential tremor, dystonia and OCD. Unrelated indications are those for which DBS is not used.

Appendix 1. STROBE Statement

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3-4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	NA
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4 & 6
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7
		(*b*) Describe any methods used to examine subgroups and interactions	6-7
		(*c*) Explain how missing data were addressed	6-7
		(*d*) If applicable, explain how loss to follow-up was addressed	NA
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	8
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	NA
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8

		(*b*) Report category boundaries when continuous variables were categorized		8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses		7
Discussion				
Key results	18	Summarise key results with reference to study objectives		9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias		13-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence		10-13
Generalisability	21	Discuss the generalisability (external validity) of the study results		10-13
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based		15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.