

Above Average: Factors Predicting High-Dose Botulinum Toxin Injection for Spasticity in a National Medicare Physician Cohort

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INTRODUCTION

- Spasticity due to injury of the central nervous system can interfere with activities of daily living, alter seating and positioning, cause pain and discomfort, and compromise skin integrity.¹ Targeted chemodenervation with botulinum toxin type A agents (BoNT-A) is a common and effective treatment.²
- Although each BoNT-A agent has its own FDA-approved dose for spasticity, physicians retain the ability to prescribe based on clinical need. There is a paucity of literature as to what physician level factors may influence their dosing choices.²⁻⁷ The aim of this analysis was to determine if there were physician or practice characteristics that were predictive of how they dose BoNT-A for physicians who treat spasticity.

METHODS

- The Medicare Provider Utilization and Payment Data: Physician and Other Supplier dataset from CMS from 2017, combined with manually collected physician data, was utilized for this analysis.⁸
- The primary outcome was to identify variables predictive of being a higher dose physician (HDP), defined as the top half of physicians by average dose, versus a lower dose physician (LDP). Neurologists and physiatrists who injected BoNT-A predominantly for spasticity were included, which was defined as having $\geq 60\%$ of BoNT-A appointments be for spasticity, as determined by Current Procedural Terminology (CPT) codes. All BoNT-A doses were converted into comparable units at a 1:1:3 ratio (onabotulinumtoxinA: incobotulinumtoxinA: abobotulinumtoxinA).
- Where appropriate, a χ^2 test for discrete data and Student's t-test for continuous measures were utilized to assess statistical significance. Significance level was set a priori at $P < 0.05$. Multivariate logistic and linear regression analyses were conducted.

RESULTS

- In total 118 physicians and 6,924 BoNT-A procedures were included.
- When comparing HDP versus LDP, HDP were more likely to be located in the Midwest, treat ≥ 5 muscles in the primary limb, inject patients more times per year, and not have an academic affiliation. A full comparison of groups can be found in **Table 1**.
- Several variables were identified as predictive of being an HDP, as can be seen in **Tables 2 & 3**. Variables not listed such as practice duration, physician gender, and number of limbs injected were not predictive and therefore not included in the final regression models.

Table 1. Comparison of Groups

Variable	Lower Dose Prescribers (n=59)	Higher Dose Prescribers (n=59)	p-value
Mean total dose, units (SD)	255 (43)	396 (63)	<0.0001
Mean dose per limb, units (SD)	220 (59)	327 (89)	<0.0001
Degree, MD	53 (90%)	51 (86%)	NS
Mean years of Practice	16.2 (9.7)	17.6 (10.4)	NS
Specialty, Physiatrist	49 (83%)	50 (85%)	NS
PMR certified	56 (95%)	56 (95%)	NS
Gender, male	36 (61%)	40 (68%)	NS
Academic Affiliation, yes	35 (59%)	24 (41%)	0.04
Metropolitan Area > 1.5 million, yes	32 (54%)	39 (66%)	NS
Mean BoNT-A patients, n (SD)	25.6 (18.5)	27.3 (16.1)	NS
Mean BoNT-A injections per patient/year	2.11 (0.47)	2.32 (0.52)	0.02
BoNT-A patients being injected for spasticity, %	84.7%	88.1%	NS
Manage baclofen pumps, yes	14 (24%)	8 (14%)	NS
Treats ≥ 5 muscles in primary limb, any claims	35 (59%)	47 (80%)	0.02
Usually treats ≥ 5 muscles in primary limb	23 (39%)	38 (64%)	0.006
Treats multiple limbs, any claims	24 (41%)	28 (47%)	NS
Usually treats multiple limbs	14 (24%)	18 (31%)	NS
Mean limbs injected/appointment (SD)	1.21 (0.27)	1.28 (0.33)	NS
Region			0.01
Midwest	10 (17%)	25 (42%)	
Northeast	24 (41%)	18 (31%)	
South	14 (24%)	13 (22%)	
West	10 (17%)	3 (5%)	
Subspecialty			NS
Other	21 (36%)	16 (27%)	
Undisclosed	12 (20%)	14 (24%)	
General Rehab	9 (15%)	11 (19%)	
SCI	13 (22%)	8 (14%)	
BIM	4 (7%)	10 (17%)	
Botulinum toxins utilized			NS
OnabotulinumtoxinA	51 (86%)	52 (88%)	
IncobotulinumtoxinA	7 (12%)	4 (7%)	
AbobotulinumtoxinA	4 (7%)	6 (10%)	
RimabotulinumtoxinB	1 (2%)	1 (2%)	

BIM = brain injury medicine certified; SCI = spinal cord injury

Table 2. Odds ratios of being an HDP versus LDP

	Odds Ratio	CI Lower	CI Upper
No Academic affiliation	Referent		
Academic Affiliation **	0.19	0.06	0.52
Metropolitan Area < 1.5 million	Referent		
Metropolitan Area ≥ 1.5 million **	3.02	1.11	9.09
Injects < 5 muscles in primary limb (all claims)	Referent		
Injects ≥ 5 muscles in primary limb (any claims)**	2.55	1.01	6.91
Region- Midwest	Referent		
Northeast**	0.34	0.11	0.99
South	0.49	0.15	1.61
West**	0.08	0.01	0.39
Subspecialty- SCI	Referent		
BIM	3.80	0.72	23.47
General Rehab	3.54	0.89	17.81
Other	1.64	0.55	6.85
Undisclosed	1.40	0.37	5.50

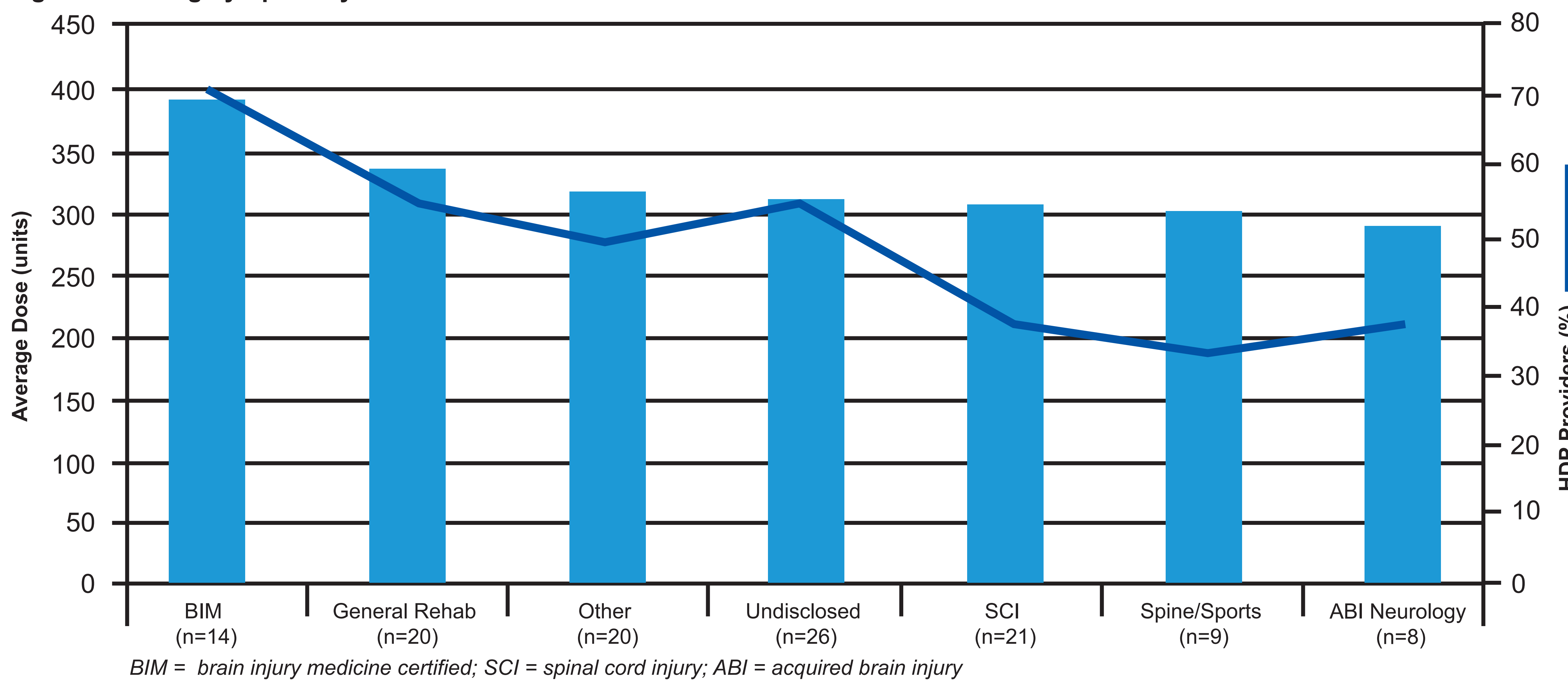
** denotes statistical significance of $p < 0.05$; BIM = brain injury medicine certified

Table 3. Results of Multivariate Linear Regression: Predicting Average Dose

	Value	CI Lower	CI Upper
No Academic affiliation	Referent		
Academic Affiliation **	-36.5	-70.2	-2.7
Metropolitan Area < 1.5 million	Referent		
Metropolitan Area ≥ 1.5 million	28.7	-5.5	62.8
Injects < 5 muscles in primary limb (all claims)	Referent		
Injects ≥ 5 muscles in primary limb (any claims)**	39.0	5.8	72.2
Region- Midwest	Referent		
Northeast	-24.5	-62.3	13.9
South	-38.2	-80.8	5.5
West**	-68.8	-122.2	-14.6
Subspecialty- SCI	Referent		
BIM**	73.3	17.6	129.0
General Rehab	39.8	-10.6	90.2
Other	7.4	-36.5	53.4
Undisclosed	-4.1	-52.3	44.2

** denotes statistical significance of $p < 0.05$; BIM = brain injury medicine certified

Figure 1. Dosing by Specialty



CONCLUSIONS

- This study identified several independent variables associated with physicians utilizing higher or lower average BoNT-A doses, several of which have never been noted before in the literature.
- BIM certifications association with higher average BoNT-A dosing is supported by existing literature that acknowledges patients with diagnoses of acquired brain injury (e.g. - stroke, TBI) may tend to receive, and benefit from, higher BoNT-A doses.^{7, 9, 10}
- Limitations to this analysis include: it was a retrospective analysis that utilized only Medicare data; a minority of the BoNT-A data may have been for indications other than spasticity since data was not linked to ICD-10 codes; the BoNT-A agents do not have identical indications for adult spasticity; only a fraction of all spasticity treating physicians were assessed as a part of this study and thus results may not be generalizable to all physicians.
- Future studies should venture to confirm and expand on these findings.

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