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Research Article

Choosing your Surgeon Wisely: Using Provider-Procedure-Volume-Specific Data for Informed Choice

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Abstract

Background: There is a longstanding association between provider-specific procedure volumes and outcomes. "To inform patients and caregivers about clinicians' experience," the Centers for Medicare and Medicaid Services (CMS) recently released datasets on procedure- and provider-specific volumes for twelve procedures provided to Traditional Medicare and Medicare Advantage enrolees in 2021. We sought to determine the utility of these datasets for consumers' informed decision making. **Methods:** Conducting a retrospective analysis of those datasets, we assigned proceduralists to procedure-specific volume quintiles, and, for each procedure and volume quintile, calculated the mean number of procedures performed, the number and specialties of providers performing them, and, at the hospital-referral region (HRR) level, the number of each procedure performed per 100,000 Medicare enrolees and the proportion of specified-procedure-providing proceduralists in the highest volume quintiles. **Results:** A substantial amount of data processing was necessary to merge relevant files and identify reasonable primary proceduralist specialties. Narrowing our analysis to that subset, we found considerable procedure-specific variation in the mean number of procedures performed and the number of high-volume proceduralists per 100,000 Medicare enrolees. When a specialist performed multiple procedure types, excepting orthopaedic surgeons, performing a greater number of procedure types was associated with lower likelihood of being in the top volume quintile. **Conclusions:** While CMS surfaced these datasets to help inform consumers, the data are complex and require a substantial amount of data manipulation to be informative. To improve consumer friendliness, CMS might identify high-volume proceduralists on its "Find & compare providers near you" tool.

Keywords: Volume-outcomes; Surgical procedures; Preference sensitive care; Informed choice

Introduction

The long-studied relationship between surgical volumes and outcomes has consistently demonstrated better outcomes among surgeons with higher annual procedure-specific surgical volumes [1,2]. Findings have influenced the Leapfrog Group, a consortium of large employers and insurers, to develop and publish minimum volume standards for surgeons for a number of surgical procedures as a proxy for anticipated better care outcomes [3].

In the absence of the availability of surgeon-specific risk-adjusted mortality and patient-reported outcomes measures – which are critical to informed patient choice – patients seeking high-quality elective surgical care might reasonably want to choose surgeons who perform relatively higher volumes of the procedure that they are considering. In early 2024, the Centers for Medicare and Medicaid Services (CMS) released several publicly available 'utilization' datasets that provide 2020 data on individual clinicians and provider- and procedure-specific volumes (and percentile rankings for those volumes) for twelve common procedures, the provider's primary specialty, and additional information on providers (such as National Provider Identifier (NPI) number, and ZIP Code in which the provider practices) [4].

To help consumers make informed choices regarding their healthcare procedures, we sought to understand: 1) Which specialists perform these procedures; 2) The distribution of volumes across procedures and Dartmouth-Atlas-defined Hospital Referral Regions (HRRs); and 3) The feasibility of using these data to identify providers with high procedure-specific volumes.

Materials and Methods

Data

CMS published publicly available datasets designed to help consumers identify provider-specific volumes and volume percentiles among those conducting twelve common procedures: cataract surgery, colonoscopy, coronary angioplasty and stenting, coronary artery bypass grafting, open hernia repair, minimally invasive hernia repair, hip replacement, knee replacement, mastectomy, pacemaker insertion, prostate resection, and spinal fusion [4].

From that CMS website [4], we obtained: the "National Downloadable File" (DAC_NationalDownloadableFile.csv) that provides National Provider Identifier (NPI)-specific information on primary specialty and practice ZIP Codes; "Utilization Data" (Utilization.csv) that provides NPI-specific information of the count of and volume percentile for each of the twelve procedures in 2020; and "2020 Clinician Utilization Data" (ClinicalUtilization_2020.csv) that provides NPI-specific data on ancillary and support services that were provided by providers listed in the "Utilization Data." The "2020 Clinician Utilization Data" file reflects the reality that multiple providers who are involved in a procedure might bill for it, including ancillary providers such as anaesthesiologists, radiologists, pathologists, assisting providers, and other professionals, even if they are not the primary proceduralist.

Data preparation

We limited data to NPIs with practice ZIP Codes located in the continental United States, Alaska, and Hawaii. We assigned providers to Dartmouth Atlas-defined HRRs based on practice ZIP Codes [5]. HRRs are aggregations of ZIP Codes of Medicare fee-for-service beneficiaries who sought care and are considered healthcare markets [5]. We also obtained the total number of Medicare enrollees in each HRR from the Dartmouth Atlas website.

In the "National Downloadable File," 697 NPIs were missing information on primary specialty or practice location; therefore, we used the National Plan and Provider Enumerator System (NPPES) [6] to provide those data.

While the data included a provider-specific 'volume percentile' for procedure-specific volumes, we assigned each provider to a quintile of volumes for a specific procedure based on volume counts. Because of clustering of volumes, we sometimes needed to create quartiles or terciles of volumes; in those cases, we report data as quintiles by retaining the lowest and the two highest quintiles. Because CMS did not provide actual volumes if the number of procedures performed was between 1-10, we substituted the number "5" for all such volumes.

Analysis

From the combined "National Downloadable File" and "Utilization Data" dataset, we calculated the number of providers and procedures that were associated with each primary specialty for each procedure. We used those data and medical practice knowledge to identify which specialty types were likely to include the primary proceduralists; we limited our data analysis to those procedure-specific specialty types. Using the "2020 Clinician Utilization Data" file, we confirmed that none of the ancillary providers were included in the primary proceduralist data.

For each procedure, we calculated mean count for each quintile, the mean CMS-assigned volume percentage, the number of providers (overall, and in the case when multiple primary specialists performed the procedure, the number in each primary specialty) in each volume quintile, and the proportion of providers who provided any of a specific procedure and were in the highest and top two volume quintiles in each HRR.

Because certain specialties might conduct several of the twelve procedures (for example, orthopaedic surgeons might perform hip replacements, knee replacements, and spinal fusions; general surgeons might perform colonoscopies, open hernia repairs, minimally invasive hernia repairs, and mastectomies), we identified proceduralists who performed multiple types of procedures and determined the proportion of providers conducting a single procedure type or multiple procedure types that were in the highest volume quintile for each specialty.

Finally, for each proceduralist type, at the HRR level we calculated the minimum and maximum number of proceduralists, the number of high-volume proceduralists per 100,000 Medicare enrollees, and the minimum and maximum proportion of proceduralists that were in the top or the top two volume quintiles.

As all data used were publicly available, the study did not constitute human subjects research and IRB approval was not required.

Results

Table 1 shows the number of providers performing each of the 12 procedures by specialty, before restricting data on ancillary providers provided in the "2020 Clinician Utilization Data" file. There were 81 primary specialty types assigned to these 12 procedures, including the ancillary providers. We used numbers of providers and the specialty-specific volumes of procedures (Supplemental Online Table 1) to identify the primary specialties for proceduralists performing each type of procedure. The number of primary specialties ranged from one (for cataract surgery, hip replacement, knee replacement, and prostate resection) to three (for pacemaker insertion or repair). The assigned primary specialists constituted between 75.3% (spinal fusion) and 99.1% (prostate resection) of the total number of specialists attributed to each procedure and between 89.1% (colonoscopy) and 99.7% (prostate resection) of the total number of procedures performed.

	Number of providers performing the procedure											
	Cataract surgery	**Colon-oscopy**	**Coronary angioplasty and stenting**	**Coronary artery bypass surgery**	**Open hernia repair**	**Minimally invasive hernia repair**	**Hip replace-ment**	**Knee replace-ment**	**Mast-ectomy**	**Pacemaker insertion or repair**	**Prostate resection**	**Spinal fusion**
Ophthalmology	**13,248**	3	2	0	0	0	0	1	3	0	1	0
Optometry	4,187	1	2	0	0	1	0	0	0	1	0	0
Gastroenterology	3	**13,485**	2	1	3	5	0	2	0	4	2	1
General surgery	5	**6,588**	4	161	**11,307**	**9,971**	51	52	**6,090**	207	42	525
Internal medicine	27	1,610	362	11	11	12	20	16	36	521	8	13
Colorectal surgery	0	1,572	2	0	243	365	0	0	24	0	3	3
Family practice	12	1,094	11	2	24	13	34	47	33	21	4	18
Cardiology	9	29	**4,691**	67	6	2	0	2	51	**4,775**	0	5
Interventional cardiology	1	4	**3,877**	10	0	0	0	1	11	**2,509**	1	0
Thoracic surgery	0	8	8	**1,507**	32	49	1	0	30	568	0	57
Cardiac surgery	0	1	24	**916**	5	3	0	0	5	383	0	26
Orthopedic surgery	4	13	1	1	5	5	**10,316**	**10,719**	7	5	2	**2,714**
Plastic and reconstructive surgery	1	7	0	1	23	8	21	10	**3,033**	11	2	16
Surgical oncology	0	122	0	1	135	138	3	3	632	1	4	6
Cardiac electrophysiology	1	3	90	1	0	0	0	0	3	**2,226**	2	0
Urology	0	22	0	3	244	302	1	3	4	1	**7,831**	7
Neurosurgery	3	3	1	1	0	0	2	0	1	0	0	**3,872**
Vascular surgery	1	43	15	58	157	81	2	1	40	38	2	570
Otolaryngology	3	9	0	1	2	1	1	1	7	0	1	348
Pain management	0	0	0	0	0	1	4	1	1	0	0	341
Interventional pain management	0	2	1	0	0	0	0	0	0	0	0	224
Total	**17,505**	**24,619**	**9,093**	**2,742**	**12,197**	**10,957**	**10,456**	**10,859**	**10,011**	**11,271**	**7,905**	**8,746**
Total primary	13,248	20,073	8,568	2,423	11,307	9,971	10,316	10,719	9,123	9,510	7,831	6,586
% by total primary	75.7%	81.5%	94.2%	88.4%	92.7%	91.0%	98.7%	98.7%	91.1%	84.4%	99.1%	75.3%
Other specialties												
Anesthesia*	107	176	2	3	10	7	15	39	11	236	2	276
Midlevels **	19	454	72	287	123	236	859	1185	240	193	78	952
Chiropractic and osteopathic manipulation	2	13	3	0	2	2	10	10	1	2	2	6
Other medical specialties***	19	348	101	7	196	100	159	257	60	657	10	208
Radiology****	6	49	18	0	2	2	14	6	443	16	13	86
Mental health#	6	1	0	1	0	0	2	3	2	1	0	3
Dentistry	0	0	0	0	0	0	0	0	0	0	0	1
General practice	3	86	0	5	72	53	6	7	37	5	2	10
Other surgical specialties^	4	203	0	1	19	112	89	47	73	1	12	7
Adjunctive therapies +	6	8	1	0	2	2	18	19	1	3	3	19
Student	3	8	0	2	4	6	0	2	2	2	0	2
Undefined non physician	1	0	0	0	0	0	0	0	0	0	0	0
Undefined physician	1	19	6	7	14	7	0	0	4	13	0	7

* Includes anaesthesiologists, anaesthesiology assistants, and CRNAs

** includes NPs, PAs, Certified nurse specialists, and certified nurse midwifes

*** includes primary specialties of adult congenital heart disease, advanced heart failure and transplant cardiology, allergy/immunology, critical care, dermatology, emergency medicine, endocrinology, geriatric medicine, haematology/oncology, hematopoietic cell transplantation, hospice, hospitalist, infectious disease, medical oncology, medical toxicology, nephrology, neurology, nuclear medicine, pathology, paediatric medicine, PM&R, preventive medicine, pulmonary disease, rheumatology, sleep medicine, and sports medicine

**** includes diagnostic radiology, interventional radiology, and radiation oncology

includes primary specialties of addiction medicine, clinical psychology, clinical social work, and psychiatry

^ includes primary specialties of gynaecology oncology, hand surgery, maxillofacial surgery, obstetrics/gynaecology, podiatry, and transplant surgery

+ includes occupational therapy, physical therapy, and podiatry

Table 1: Number of providers performing each procedure type by specialty. Bold numbers indicate primary specialties.

Limiting further results to the primary specialties, for each procedure, the top part of Table 2 shows the mean volumes and CMS-assigned procedure-specific percentile rankings for each volume-based quintile. The quintiles align with mean volumes and volume percentiles, but the mean number of procedures in each quintile varied considerably (for example in Quintile 5 from 22.06 for open hernia repair to 793.14 for cataract surgery). The bottom part of Table 2 shows the distribution of numbers of providers for each procedure across volume quintiles. At the procedure level, the proportion of providers in the highest 2 quintiles ranged from 39% (prostate resection) to 58% (spinal fusion) and in the highest quintile from 20% (for coronary angioplasty and stenting, open hernia repair, and prostate resection) to 29% (for spinal fusion). At the specialty level, the proportions varied considerably. For example, only 2% of general surgeons were in the highest quintile for colonoscopy while 72% of cardiac electrophysiologists were in the highest quintile for pacemaker insertion or repair.

	Quintile						
Mean volumes (and percentiles)	**1**	**2**	**3**	**4**	**5**		
Cataract surgery	5 (0)	16.5 (36)	82.6 (50)	268.8 (70)	793.14 (90)		
Colonoscopy	5 (0)	31.0 (31)	90.8 (50)	176.4 (70)	357.53 (90)		
Coronary angioplasty and stenting	5 (0)	16.6 (30)	30.3 (49)	49.7 (69)	102.35 (90)		
Coronary artery bypass grafting	5 (0)	16.8 (32)	30.6 (50)	47.1 (70)	82.98 (90)		
Open hernia repair	5 (0)			11.0 (79)	22.06 (90)		
Minimally invasive hernia repair	5 (0)			15.0 (70)	36.24 (90)		
Hip replacement	5 (0)		16.7 (51)	37.7 (70)	96.86 (89)		
Knee replacement	5 (0)	15.3 (34)	31.8 (50)	63.0 (70)	147.08 (90)		
Mastectomy	5 (0)		11.5 (57)	18.7 (70)	56.61 (89)		
Pacemaker insertion or repair	5 (0)			23.2 (71)	78.61 (89)		
Prostate resection	5 (0)	11.5 (36)	16.8 (49)	27.1 (70)	54.90 (90)		
Spinal fusion	5 (0)		17.3 (52)	37.1 (70)	87.63 (90)		
	Quintile					**Proportion in**	
Number of providers	**1**	**2**	**3**	**4**	**5**	**Highest 2 quintiles**	**Highest quintile**
Cataract surgery	2096	901	3248	3465	3527	**53%**	**27%**
Colonoscopy	3214	3373	4195	4538	4733	**46%**	**24%**
Gastroenterology	429	1442	2952	4032	4619	64%	34%
General surgery	2785	1931	1243	506	114	9%	2%
Coronary angioplasty and stenting	1728	1497	1778	1819	1739	**42%**	**20%**
Cardiology	1247	889	902	881	769	35%	16%
Interventional cardiology	481	608	876	938	970	49%	25%
Coronary artery bypass grafting	319	425	570	548	561	**46%**	**23%**
Cardiac surgery	115	144	210	213	234	49%	26%
Thoracic surgery	204	281	360	335	327	44%	22%
Open hernia repair	8818			219	2258	**22%**	**20%**

Minimally invasive hernia repair	5743			2057	2164	**42%**	**22%**
Hip replacement	3812		1988	2211	2303	**44%**	**22%**
Knee replacement	2265	1310	2348	2387	2407	**45%**	**22%**
Mastectomy	5202		458	1969	2118	**42%**	**22%**
General surgery	3359		258	1051	1417	41%	23%
Plastic and reconstructive surgery	1706		187	804	333	38%	11%
Surgical oncology	137		13	114	368	76%	58%
Pacemaker insertion or repair	5338			1805	2364	**44%**	**25%**
Cardiac electrophysiology	109			509	1608	95%	72%
Cardiology	3045			1040	688	36%	14%
Interventional cardiology	2184			256	68	13%	3%
Prostate resection	2647	434	1664	1546	1539	**39%**	**20%**
Spinal fusion	1464		1316	1874	1929	**58%**	**29%**
Neurosurgery	947		835	1081	1007	54%	26%
Orthopedic surgery	517		481	793	922	63%	34%

Table 2: Mean volumes (and CMS-assigned percentile rankings) for each procedure by volume quintile (top) and distribution of the number of providers by volume quintiles (bottom). The proportion of procedure-specific providers in the highest and highest two quintiles is provided (bolded numbers indicate the combined proceduralists).

Table 3 provides information on the distribution of specialties when the specialists might have performed more than one of the 12 procedures. For cardiologists, interventional cardiologists, and general surgeons, a smaller number of types of procedures performed was associated with a higher proportion of those specialists being in the highest volume quintile. For orthopaedic surgeons, a higher proportion of specialists were in the highest volume quintile if they performed two of the possible procedures, as opposed to one or all three.

Provider type	**One procedure**		**Two procedures**		**Three procedures**		**Four procedures**	
Cardiologists	**Providers**	**Procedures**	**Providers**	**Procedures**	**Providers**	**Procedures**	**Providers**	**Procedures**
Quintile 1	1534	7670	2761	13795				
Quintile 2	326	5262	562	9380				
Quintile 3	293	8755	609	18357				
Quintile 4	693	22329	1229	44549				
Quintile 5	690	56125	767	71000				
Percent in Quintile 5	**20%**	**56%**	**13%**	**45%**				
Interventional cardiologists								
Quintile 1	283	1415	2384	11920				
Quintile 2	260	4288	348	5891				

Quintile 3	300	9145	577	17646				
Quintile 4	302	14743	893	37394				
Quintile 5	283	30428	756	73336				
Percent in Quintile 5	**20%**	**51%**	**15%**	**50%**				
Orthopedic surgeons								
Quintile 1	2319	11595	3930	19650	339	1695		
Quintile 2	274	4225	992	15218	44	648		
Quintile 3	835	19819	3766	92012	211	4468		
Quintile 4	1005	44527	4240	212510	137	6036		
Quintile 5	1001	97783	4566	555392	61	6045		
Percent in Quintile 5	**18%**	**55%**	**26%**	**62%**	**8%**	**32%**		
General surgeons								
Quintile 1	2814	14070	6258	31290	7168	35840	4521	22445
Quintile 2	218	5974	424	11683	766	22895	531	16244
Quintile 3	96	5809	258	19301	579	41784	572	41896
Quintile 4	331	9172	978	25123	1448	51956	1086	51868
Quintile 5	1194	73382	1820	61940	1958	69955	990	43475
Percent in Quintile 5	**26%**	**68%**	**19%**	**41%**	**16%**	**31%**	**13%**	**25%**

Table 3: Distribution of specialties by the number of providers and the number of procedures they performed by each specialty type. Cardiologists and interventional cardiologists could perform coronary angioplasty and stenting and pacemaker insertion or repair; orthopaedic surgeons could perform hip replacement, knee replacement, and spinal fusion; and general surgeons could perform colonoscopy, open hernia repair, minimally invasive hernia repair, and mastectomy. The percentile of providers and procedures in the highest volume quintile is provided as a function of the number of procedures performed by the specialist.

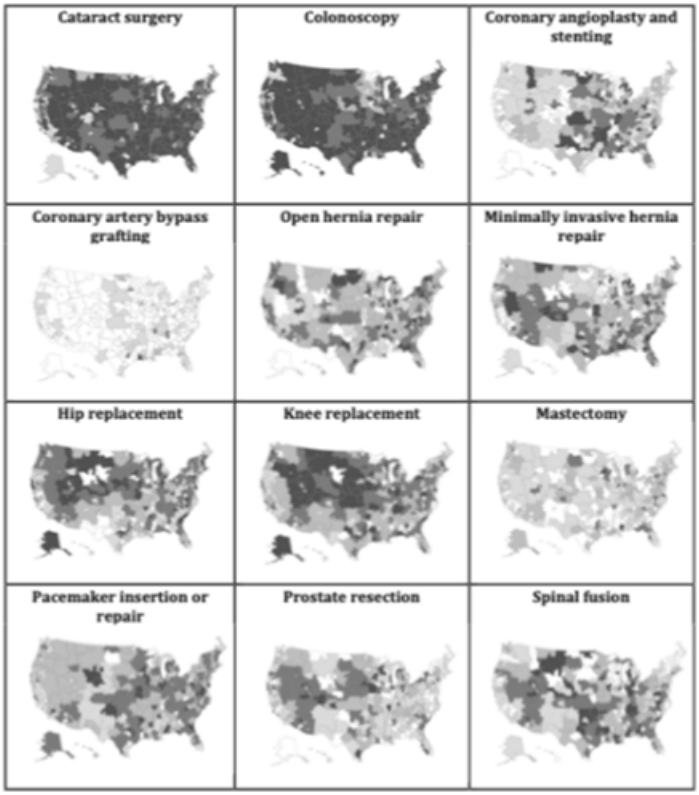
For each procedure type, at the HRR level, Table 4 shows the minimum and maximum total number of proceduralists, total number of proceduralists per 100,000 Medicare enrolees, and the top two and the top volume-based quintiles; further, the number of HRRs with no providers at all and none in the top two and the top volume-based quintiles is provided. While most HRRs have at least one proceduralist, a substantial proportion of HRRs do not have providers in the top quintile (for example, 33 HRRs do not have a coronary angioplasty and stenting proceduralist, 96 do not have a coronary artery bypass grafting proceduralist, 20 do not have a minimally invasive hernia repair proceduralist, 26 do not have a hip replacement proceduralist, 25 do not have a mastectomy proceduralist, 48 do not have a prostate resection proceduralist, and 37 do not have a spine fusion proceduralist in the top volume quintile). Supplemental Online Table 2 provides data on these variables for each HRR.

Proceduralist type	Measure	Providers in an HRR		HRRs with no providers
		Minimum	Maximum	
Cataract surgery proceduralists	Total	0	450	1
	Per 100,000 Medicare enrolees	0	61.90	
	Percent in the top 2 quintiles	0%	100%	1
	Percent in top quintile	0%	100%	5
Colonoscopy proceduralists	Total	3	492	0
	Per 100,000 Medicare enrolees	8.18	118.49	
	Percent in the top 2 quintiles	0%	90%	1
	Percent in top quintile	0%	70%	3
Coronary angioplasty and stenting proceduralists	Total	1	287	0
	Per 100,000 Medicare enrolees	2.34	46.00	
	Percent in the top 2 quintiles	0%	100%	4
	Percent in top quintile	0%	100%	33
Coronary artery bypass grafting proceduralists	Total	0	61	14
	Per 100,000 Medicare enrolees	0	18.03	
	Percent in the top 2 quintiles	0%	100%	37
	Percent in top quintile	0%	100%	96
Open hernia repair proceduralists	Total	2	223	0
	Per 100,000 Medicare enrolees	5.45	53.04	
	Percent in the top 2 quintiles	0%	100%	17
	Percent in top quintile	0%	100%	18
Minimally invasive hernia repair proceduralists	Total	1	199	0
	Per 100,000 Medicare enrolees	2.73	46.40	
	Percent in the top 2 quintiles	0%	100%	3
	Percent in top quintile	0%	63%	20
Hip replacement proceduralists	Total	0	208	2
	Per 100,000 Medicare enrolees	0	61.12	
	Percent in the top 2 quintiles	0%	86%	2
	Percent in top quintile	0%	67%	26
Knee replacement proceduralists	Total	0	210	1
	Per 100,000 Medicare enrolees	0	61.12	
	Percent in the top 2 quintiles	0%	88%	2
	Percent in top quintile	0%	55%	17

Mastectomy proceduralists	Total	2	280	0
	Per 100,000 Medicare enrolees	5.45	42.78	
	Percent in the top 2 quintiles	0%	82%	1
	Percent in top quintile	0%	67%	25
Pacemaker insertion or repair proceduralists	Total	2	232	0
	Per 100,000 Medicare enrolees	4.69	59.15	
	Percent in the top 2 quintiles	0%	100%	2
	Percent in top quintile	0%	100%	9
Prostate resection proceduralists	Total	0	215	2
	Per 100,000 Medicare enrolees	0	80.98	
	Percent in the top 2 quintiles	0%	100%	14
	Percent in top quintile	0%	100%	48
Spinal fusion proceduralists	Total	0	165	1
	Per 100,000 Medicare enrolees	0	30.66	
	Percent in the top 2 quintiles	0%	100%	8
	Percent in top quintile	0%	100%	37

Table 4: For the total number of proceduralists, the number of proceduralists per 100,000 Medicare enrolee, and the highest two and the highest volume-based quintiles, the minimum and maximum number of providers in one of the 306 hospital referral regions (HRRs) and the number of HRRs with no providers.

For each procedure, the Figure shows variation in the number of highest-volume-quintile proceduralists per 100,000 Medicare enrolees at the HRR level. As expected, there are more such proceduralists per-capita for the more common procedures (cataract surgery, colonoscopy, knee replacement, and hip replacement) and fewer for less common procedures (coronary artery bypass grafting, open and minimally invasive hernia repair, and mastectomy). The distribution of high-volume proceduralists varies by procedure as well, with relatively fewer cataract surgery and colonoscopy proceduralists in the Midwest, but relatively more high-volume coronary angioplasty and stenting, knee replacement, pacemaker insertion or repair, and spinal fusion proceduralists in the Midwest.



Range of proceduralists per 100,000 Medicare enrollees	**0 - 1.71**	**1.72 - 3.13**	**3.14 - 4.66**	**4.67 - 6.80**	**6.81 - 28.29**

Figure 1: For each procedure, variation in the number of highest-volume-quintile proceduralists per 100,000 Medicare enrolees at the Hospital Referral Region level.

Discussion

We used publicly available data, generated by CMS to help consumers identify proceduralists with higher volumes for twelve procedures, to identify the types and numbers of specialists who perform those procedures, the volumes of procedures performed, the distribution of procedures and proceduralists across volume quintiles, the geographic distribution of proceduralists, and, for four specialties, the relationship between a specialist performing multiple procedure types and their likelihood of being a high volume proceduralist. We found that only certain specialists should be considered when determining the numbers of procedures performed, that there is substantial variation in numbers of procedures and providers across volume-based quintiles and across HRRs, and that, for general surgeons, cardiologists, and interventional cardiologists, doing more types of procedures is associated with lower likelihood of being in the top quintile for any one of them.

We also found that the data are complex, require some knowledge of how healthcare works, and necessitate a substantial amount of data manipulation. While CMS is to be commended on making data publicly available, the data are not consumer friendly. And, while CMS has incorporated volume percentile data into their "Find & compare providers near you" tool [7], that tool does not provide consumers the opportunity to easily compare volumes or to differentiate who might be primary proceduralists.

Our findings have implications for those who seek to impart information on procedure-specific provider volumes to help patients make informed decisions about from whom to seek care. Our findings suggest that volumes should be compared only for providers who can reasonably perform particular procedures: for instance, while we included gastroenterologists and general surgeons as primary proceduralists for colonoscopies based on the overwhelming proportion of colonoscopies that those specialties perform, our data support that internists, family practitioners, and colorectal surgeons possibly should considered as minor contributors to overall volumes, as has been suggested [8]. Further, in certain parts of the country, for certain procedures, high-volume proceduralists simply may not be available.

Our findings have ramifications for providers. Only a subset of providers who did the procedures were high volume proceduralists; within markets, the availability of high-volume providers varied and could be very limited. Anticipating that consumers and payers will seek high-value care when obtaining procedures in the future, in the absence of widely available risk-adjusted mortality rates (which might be very low and unstable for spinal fusion and joint arthroplasties) or risk-adjusted longitudinal patient-reported outcome metrics (which may be a long way off), our findings suggest that providers might strategically focus on doing higher volumes of fewer types of procedures to win the business of consumers and payers who seek volume-based guidance.

That would not be a bad thing for healthcare. In addition to a wealth of data supporting that higher volume surgeons have better patient [1,9,10] and economic [11] outcomes, there is evidence that high-volume knee arthroplasty [12], shoulder arthroplasty [13], and rotator cuff [14] surgeons use healthcare resources more efficiently. Surgeons concentrating on fewer procedures might help bend the cost curve and improve patient outcomes.

Further, if data on volumes were readily available to consumers – and consumers, healthcare administrators, and insurers actually used them (for instance, there is evidence that most US hospital networks include hospitals that do not meet minimum volume standards) [15] – patients might self-direct to higher-volume proceduralists, thereby improving care outcomes and reducing care costs. To facilitate this, CMS might make such procedure-specific volume data readily available by including three features: an easy way to search for nearby high volume proceduralists for a selected procedure, a table that lists key variables for up to five proceduralists that might influence choice (like national and local percentage volume ranking for the procedure and provider gender, board certification status, medical school attended, year of graduation, and medical board actions taken), and the hospitals in which each proceduralist operates (including easily accessible comparisons of CMS hospital-level quality rankings).

Our study is limited by its dependence on Medicare claims data; had they been available, more comprehensive datasets might allow CMS to identify high volume proceduralists across different insurance types. Medicare claims may not be representative of the total volumes of procedures that providers perform. As with any analysis of claims data, ours is further limited by dependency on the accuracy of procedure coding data. We used only data from 2020, the first year of the pandemic; data from different years might generate different results. Finally, we were not able to ascertain whether the procedures we examined were appropriate; there is a long history examining geographic variation in spine surgery that questions the appropriateness of some surgeries in high volume areas [16,17].

Conclusions

Despite these limitations, we were able to use publicly available data to compare the distribution of procedure-specific volumes across the specialists who perform them, determine that concentrating on performing fewer procedure types might be associated with being in a higher volume quintile, and identify geographies with a paucity of providers who conduct adequate volumes of specific procedures. This information might help patients determine from whom to obtain care, could steer physicians with specific procedural interests into low volume and high-need areas, and inform federal and state policy and funding choices that could support that steerage. To better support patients as they make care decisions, future work should examine other specialties and procedures, incorporate measures of appropriateness of care, and incorporate measures of patient-reported outcomes and out-of-pocket care costs – ideally providing long-term comparisons of patient outcomes among those who had a common underlying condition and either did or did not obtain an elective surgical procedure.

Ethical Guidelines

As all data used were publicly available, the study did not constitute human subjects research and IRB approval was not required.

Conflicts of Interest

Drs. Weeks, Weinstein, and Lavista, Mr. Demuro, and Ms. Michael were employed by Microsoft. Mr. Lee is CEO of Yura Health. Dr. Weeks is on an advisory board for Yura Health.

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