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Health Policy Review

Update on Reversal and Decline of Growth of Utilization of Interventional Techniques In Managing Chronic Pain in the Medicare Population from 2000 to 2018

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Background: The cost of US health care continues to increase, with treatments related to low back and neck pain and other musculoskeletal disorders accounting for the third highest amount of various disease categories. Interventional techniques for managing pain apart from conservative modalities and surgical interventions, have generally been thought to be growing rapidly. However, a recent analysis of utilization of interventional techniques from 2000 to 2016 has shown a modest decline from 2009 to 2016, compared to 2000 to 2009.

Objectives: The objectives of this analysis include providing an update on utilization of interventional techniques in managing chronic pain in the Medicare population from 2009 to 2018 in the fee-for-service (FFS) Medicare population of the United States.

Study Design: Utilization patterns and variables of interventional techniques in managing chronic pain were assessed from 2000 to 2009 and from 2009 to 2018 in the FFS Medicare population of the United States.

Methods: The data for the analysis was obtained from the master database from the Centers for Medicare & Medicaid Services (CMS) physician/supplier procedure summary from 2000 to 2018.

Results: The analysis of data showed that there was a decline in utilization of interventional techniques from 2009 to 2018 of 6.7%, with an annual decline of 0.8% per 100,000 FFS Medicare population, despite an increase of 0.7% per year of population growth (3.2% of those 65 years or older) and a 3% annual increase in Medicare participation from 2009 to 2018. Medicare data from 2000 to 2009 showed an increase of 11.8% per year per 100,000 individuals of the Medicare population. The 2009 to 2018 data also showed a 2.6% annual decrease in the rate of utilization of epidural and adhesiolysis procedures per 100,000 population of FFS Medicare, and a 1% decrease for disc procedures and other types of nerve blocks, while there was an increase of 0.9% annually for facet joint interventions and sacroiliac joint blocks.

Limitations: Limitations of this analysis include: only the Medicare population was utilized, and among the Medicare population, only the FFS population was evaluated; utilization patterns in Medicare Advantage Plans, which constitutes almost 30% of the population were not considered. Further, the utilization data for individual states was sparse and may not be accurate.

Conclusion: The decline in utilization of interventional techniques continued from 2009 to 2018 with 6.7% per 100,000 Medicare population, with an annual decline of 0.8%, despite an increase in the population rate and Medicare enrollees of 0.7% and 3% annually.

Key words: Interventional pain management, chronic spinal pain, interventional techniques, epidural injections, adhesiolysis, facet joint interventions, sacroiliac joint injections, disc procedures, other types of nerve blocks

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The US Federal Government Actuary estimated that US health care spending reached $3.65 trillion in 2018 (1). 2018 expenditures increased 4.4% over 2017; however, the national health expenditures survey and estimations forecast an average annual growth rate of 5.5% from 2018 to 2027 (2). The 2018 cost of $3.65 trillion in spending represents $11,212 per person. In particular, US spending on personal and public health care from 1996 to 2013 (3), showed an estimated spending of $87.6 billion in managing low back and neck pain and $95.5 billion in managing musculoskeletal disorders, yielding a total spending on musculoskeletal disorders and low back and neck pain of approximately $183 billion. $183 billion is the third highest amount of the various disease categories (3).

The description of the US Burden of Disease Collaborations and the State of US health care from 1990 to 2010 accounted for nearly half of the US healthcare burden to morbidity and chronic disability (4). Low back pain was rated as number one, other musculoskeletal disorders ranking number 2, with neck pain ranking number 3, and depression and anxiety as number 4 and 5, among the 30 leading diseases and injuries contributing to years lived with a disability, all inter-related with chronic pain.

Based on the current regulations, national healthcare spending is projected to grow to nearly $6 trillion by 2027 (2). Public spending also continues to increase with most of the growth due to higher prices, but with administrative costs increasing rapidly compared to other services (1,2). Apart from increased government spending on health care, faster inflation also attributed to increased costs; however, the focus of policymakers and the public continues to be on reducing the utilization or provider reimbursement rates to reduce health care expenditures. In fact, with the Affordable Care Act (ACA) or Obamacare, the most monumental change in the US health care policy since the passage of Medicare and Medicaid in 1965, was enacted the 3 primary goals were increasing the number of insured, improving the quality of care, and controlling health care costs (5,6). The ACA, while increasing the number of insureds (affordability), does not appear to have increased access to (health care). With increasing regulations, administrative expenses for all sectors, payers, and providers continue to escalate (7-13). Consequently, interventional techniques, which are some of the commonly utilized treatments in managing chronic pain have been under scrutiny, not only for their utilization, but for clinical and cost utility, medical necessity and indications. importantly, over the years, all modalities of pain management have shown significant escalation in utilization, including opioids. Prescription opioids have helped result in the creation of the opioid epidemic and escalating deaths, even though in recent years there have been declines in prescriptions as well as prescription opioid related deaths (14-29).

The utilization patterns of interventional techniques have been well studied with overall increases until 2009 and an overall decline since 2009 (30-37). These studies also showed a reversal of the utilization ratio of interlaminar epidurals to transforaminal epidurals from 7 in 2000 to one in 2016, the ratio of lumbosacral facet joint injections compared to facet neurolysis procedures decreasing from 6.7% in 2009 to 2.2% in 2016; that is radiofrequency procedures have increased relative to facet medial branch blocks (30-34). Similarly, the ratio of cervicothoracic facet joint injections compared to neurolytic procedures decreased from 8.85% in 2000 to 2.8% in 2016. Similar results were shown for radiofrequency ablation vs facet nerve blocks from 2007 to 2016 (38).

Further, there is an extensive literature demonstrating the clinical and cost utility of various interventional techniques in the form of randomized controlled trials, systematic reviews, cost utility analysis, and evidence for real-world scenarios (39-65). However, discordant opinions and conclusions, with lack of agreement between proponents and opponents of the effectiveness and appropriateness of multiple interventional techniques continues (56-58). While the opponents cite lack of effectiveness, proponents emphasize evidence for conflicts of interest, or confluence of interest in interpretation leading to inappropriate conclusions as the basis of discordant results. In fact, multiple factors have been described in reference to the evidence-based medicine (EBM) and its survival into the future in the era of inappropriate evidence synthesis and application of these standards to the public in general, based on numerous conflicts and confluence of interest (56-58).

There have been attempts to control the utilization of interventional techniques by a variety of means, including reimbursement reductions, coding changes, bundling, local coverage determinations (LCDs), and increased oversight from various agencies. These aspects are augmented by opponents citing the lack of effectiveness.

This retrospective cohort study of utilization patterns of interventional techniques evaluates the period

covering 2000 to 2018, updating previous publications (30-35,38) examining the US FFS Medicare population.

Methods

Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidance (66) was utilized in performing the study. The public use files or non-identifiable data, which is non-attributable and non-confidential, available through the Centers for Medicare & Medicaid Services (CMS) database was utilized (67).

Study Design

The study was designed to assess usage or utilization patterns and variables of multiple interventional techniques in managing chronic pain from 2000 to 2018 in the Medicare FFS population in the United States, with inclusion of the majority of the interventional techniques. Excluded procedures included continuous epidurals, neurolytic procedures, trigger point injections, vertebral augmentation procedures, and implantable devices.

Setting

The national database of specialty usage data files from CMS in the FFS Medicare population in the United States (67).

Participants

All of the participants available from the database, which included all of the FFS Medicare recipients whether they were on Medicare due to Social Security disability, Social Security insurance, or retirement from 2000 to 2018.

Variables

Variables assessed included not only the usage patterns of various procedures in the Medicare population from 2000 to 2018, but multiple characteristics in reference to the Medicare population and the growth of the Medicare population.

Historically, the majority of interventional procedures have been performed by interventional pain physicians represented by the specialties of interventional pain management (-09), pain medicine (-72), anesthesiology (-05), physical medicine and rehabilitation (-25), neurology (-13), and psychiatry (-26). A multitude of other specialties perform interventional procedures infrequently. Based on Medicare designations, specialties grouped into interventional pain management include orthopedic surgery (-20), general surgery (-17), and neurosurgery (-14) as a surgical group; diagnostic radiology (-30), and interventional radiology (-94) as radiological group; all other physicians as a separate group; and all other providers were considered as other providers.

The current procedural terminology procedure codes for interventional techniques utilized were those in effect during 2000 to 2018 as follows:

- Epidural and adhesiolysis procedures (CPT 62280, 62281, 62282, 62310, 62320-new, 62321-new, 62311, 62322-new, 62323-new, 64479, 64480, 64483, 64484, 62263, 62264)
- Facet joint interventions and sacroiliac joint blocks (CPT 64470, 64472, 64475, 64476, 64490, 64491-new, 64492-new, 64493-new, 64494-new, 64495-new, 64622, 64623, 64626, 64627, 64633-new, 64634-new, 64635-new, 64636-new, 27096)
- Discography and disc decompression (CPT 62290, 62291, 62287)
- Other types of nerve blocks (CPT 64400, 64402, 64405, 64408, 64410, 64412, 64413, 64417, 64420, 64421, 64425, 64430, 64445, 64505, 64510, 64520, 64530, 64600, 64605, 64610, 64613, 64620, 64630, 64640, 64680).

The data were also assessed based on the place of service – facility (ambulatory surgery center or hospital outpatient department) or non-facility (office).

Data Sources

All of the analyzed data were obtained from the CMS Physician/Supplier Procedure Summary Master Data from 2000 to 2018 (67). These data included all FFS Medicare participants below the age of 65 and above the age of 65 receiving interventional techniques irrespective of the type of disability.

Measures

The 100% dataset from CMS consists of a CPT code with modifier indicating an additional procedure or bilateral procedure, specialty codes, a place of service, a Medicare carrier number, total services and charges submitted, allowed and denied services, and amounts paid. The usage pattern analysis included all allowed services configured by taking services submitted minus services denied and any services with zero payments. Allowed services were also assessed for each procedure, and rates were calculated based on Medicare beneficiaries for the corresponding year and are reported as procedures per 100,000 Medicare beneficiaries. In this analysis, usage patterns were analyzed only once based on the location rather than duplicating the measure-

ments for physician services and facility services.

Assessment measures utilized were of services as well as rate of usage per 100,000 individuals of the Medicare population.

Bias

The data was purchased from CMS by the American Society of Interventional Pain Physicians (ASIPP). The study was conducted with the internal resources of the primary authors' practice without external funding or grants, either from industry or elsewhere.

In this analysis, we have utilized all patients enrolled in FFS Medicare, instead of only patients aged 65 or older as in other evaluations (68,69), due to the finding that a significant proportion of patients below the age of 65 undergo interventional techniques (70,71). With emerging affordable insurance under Obamacare, increasing disability, and increasing population over the age of 65, Medicare represents the second largest health care payer next to Medicaid in the United States, with over 59.6 million beneficiaries in 2018 (72). Consequently, the interventional techniques performed on Medicare beneficiaries increasingly represent a large proportion of the procedures for chronic pain in the United States.

Study Size

The study size is large with the inclusion of all patients under Medicare FFS undergoing interventional procedures in all settings for all regions in the United States for chronic spinal pain from 2000 to 2018.

Data Compilation

The data were compiled using Microsoft Access 2003 and Microsoft Excel 2003 (Microsoft Corporation, Redmond, WA).

Results

Participants

Participants in this assessment included all FFS Medicare recipients from 2000 to 2018.

Descriptive Data of Population Characteristics

As shown in Table 1, from 2000 to 2018, the US population older than 65 years of age increased 49.2% at an annual growth rate of 2.2%, compared to the total US population of 15.9% at an annual growth rate of 0.8%. The US population grew at an annual rate of 0.9% from 2000 to 2009, compared to 0.7% from 2009 to 2018. In contrast, those aged 65 or older grew at an annual rate of 1.3% from 2000 to 2009, compared to 3.2% from 2009 to 2018. The number of individuals participating in Medicare grew at an annual rate of 2.3%, 1.6%, and 3% from 2000 to 2018, 2000 to 2009, and 2009 to 2018 respectively.

The rate of interventional pain management services per 100,000 individuals of the Medicare population declined from 2009 to 2018 at an annual rate of -0.8%, in contrast to an annual growth rate of 5.3% and 11.8%, from 2000 to 2018, and from 2000 to 2009, respectively. Figure 1 shows a comparative analysis of annual US population growth, Medicare participation, and utilization of interventional pain management services.

Utilization Characteristics

Table 2 and Figs. 2 to 4 show the utilization characteristics of interventional techniques in the FFS Medicare population from 2000 to 2018.

Table 2 and Fig. 2 show a decline of overall interventional technique at an annual rate of 0.8% per 100,000 individuals of the Medicare population, with epidural and adhesiolysis procedures declining at 2.6%, disc procedures and other types of nerve blocks declining at 1%, with an increase of 0.9% for facet joint interventions and sacroiliac joint blocks from 2009 to 2018. In contrast, prior years showed significant increases.

Specialty Characteristics

Appendix Table 1 and Appendix Fig. 1 show frequency of utilization of interventional pain management techniques based on specialty designation.

State Distribution Characteristics

Appendix Table 2 shows the rate of utilization of interventional pain management techniques from 2009 to 2018 based on Medicare carrier contractors. Noridian, the largest and most aggressive carrier regarding the development of specific interventional policies to be utilized across the nation to reduce utilization patterns, showed an overall decrease of 0.3%. This included the highest growth rate states of Alaska and Utah at 5% and 4.2%, with high growth rate states of Arizona at 3.2%. The highest decreases in Noridian states were observed in the state of California at 2.2%, followed by Washington of 1.7% even though their base utilization rate was 8,022 for California and 6,164 for Washington, compared to 10,143 nationwide.

We also assessed the rate of utilization of interven-

Table 1. *A summary of the frequency of utilization of various categories of interventional procedures in the FFS Medicare population from 2000 to 2018.*

Year	U.S. Population			Fee-for-service Medicare Beneficiaries				Utilization of all interventional techniques			
	Total Population (,000)	≥ 65 Years (,000)		Number of individuals participating in Medicare	% to U.S. population	≥ 65 years (,000) (Percent)	< 65 years (,000) Percent	Services	% of Change from Previous Year	Per 100,000 population	% of Change from Previous Year
		Number	% of US population								
2000	282,172	35,077	12.40%	39,632	14.0%	34,262 (86.5%)	5,370 (13.5%)	1,469,495	-	3,708	-
2001	285,040	35,332	12.40%	40,045	14.0%	34,478 (86.1%)	5,567 (13.9%)	1,760,456	19.8%	4,396	18.6%
2002	288,369	35,605	12.30%	40,503	14.0%	34,698 (85.7%)	5,805 (14.3%)	2,183,052	24.0%	5,390	22.6%
2003	290,211	35,952	12.40%	41,126	14.2%	35,050 (85.2%)	6,078 (14.8%)	2,559,323	17.2%	6,223	15.5%
2004	292,892	36,302	12.40%	41,729	14.2%	35,328 (84.7%)	6,402 (15.3%)	3,335,047	30.3%	7,992	28.4%
2005	295,561	36,752	12.40%	42,496	14.4%	35,777 (84.2%)	6,723 (15.8%)	3,660,699	9.8%	8,614	7.8%
2006	299,395	37,264	12.40%	43,339	14.5%	36,317 (83.8%)	7,022 (16.2%)	4,146,124	13.3%	9,567	11.1%
2007	301,290	37,942	12.60%	44,263	14.7%	36,966 (83.5%)	7,297 (16.5%)	4,111,127	-0.8%	9,288	-2.9%
2008	304,056	38,870	12.80%	45,412	14.9%	37,896 (83.4%)	7,516 (16.6%)	4,433,411	7.8%	9,763	5.1%
2009	307,006	39,570	12.90%	45,801	14.9%	38,177 (83.4%)	7,624 (16.6%)	4,645,679	4.8%	10,143	3.9%
2010	308,746	40,268	13.00%	46,914	15.2%	38,991 (83.1%)	7,923 (16.9%)	4,578,977	-1.4%	9,760	-3.8%
2011	311,583	41,370	13.28%	48,300	15.5%	40,000 (82.8%)	8,300 (17.2%)	4,815,673	5.2%	9,970	2.2%
2012	313,874	43,144	13.75%	50,300	16.0%	41,900 (83.3%)	8,500 (16.9%)	4,947,974	2.7%	9,837	-1.3%
2013	316,129	44,704	14.14%	51,900	16.4%	43,100 (83.0%)	8,800 (17.0%)	4,932,950	-0.3%	9,505	-3.4%
2014	318,892	46,179	14.48%	53,500	16.8%	44,600 (83.4%)	8,900 (16.5%)	5,025,904	1.9%	9,394	-1.2%
2015	320,897	47,734	14.88%	54,900	17.1%	46,000 (83.7%)	9,000 (16.3%)	5,243,036	4.3%	9,550	1.7%
2016	323,127	49,244	15.24%	56,500	17.5%	47,500 (84.1%)	9,000 (15.9%)	5,509,306	5.1%	9,751	2.1%
2017	326,625	51,055	15.63%	58,000	17.8%	49,200 (84.8%)	8,900 (15.3%)	5,558,893	0.9%	9,584	-1.7%
2018	327,167	52,347	16.00%	59,600	18.2%	50,800 (85.2%)	8,800 (14.8%)	5,639,608	1.5%	9,462	-1.3%
Percentage of change from 2000 to 2018											
Change	15.9%	49.2%		50.4%		48.3%	63.9%	283.8%		155.2%	
GM	0.8%	2.2%		2.3%		2.2%	2.8%	7.8%		5.3%	
Percentage of change from 2000 to 2009											
Change	8.8%	12.8%		15.6%		11.4%	42.0%	216.1%		173.6%	
GM	0.9%	1.3%		1.6%		1.2%	4.0%	13.6%		11.8%	

Table 1 (cont.). *A summary of the frequency of utilization of various categories of interventional procedures in the FFS Medicare population from 2000 to 2018.*

Year	U.S. Population			Fee-for-service Medicare Beneficiaries				Utilization of all interventional techniques			
	Total Population (,000)	≥ 65 Years (,000)		Number of individuals participating in Medicare	% to U.S. population	≥ 65 years (,000) (Percent)	< 65 years (,000) Percent	Services	% of Change from Previous Year	Per 100,000 population	% of Change from Previous Year
		Number	% of US population								
Percentage of change from 2009 to 2018											
Change	6.6%	32.3%		30.1%		33.1%	15.4%	21.4%		-6.7%	
GM	0.7%	3.2%		3.0%		3.2%	1.6%	2.2%		-0.8%	

GM= geometric average annual change; *(Excluding continuous epidurals, intraarticular injections, trigger point and ligament injections, peripheral nerve blocks, vertebral augmentation procedures, and implantables)

The US total included DC, Hawaii/Guam, Puerto Rico/Virgin Islands, and Railroad FFS Medicare data

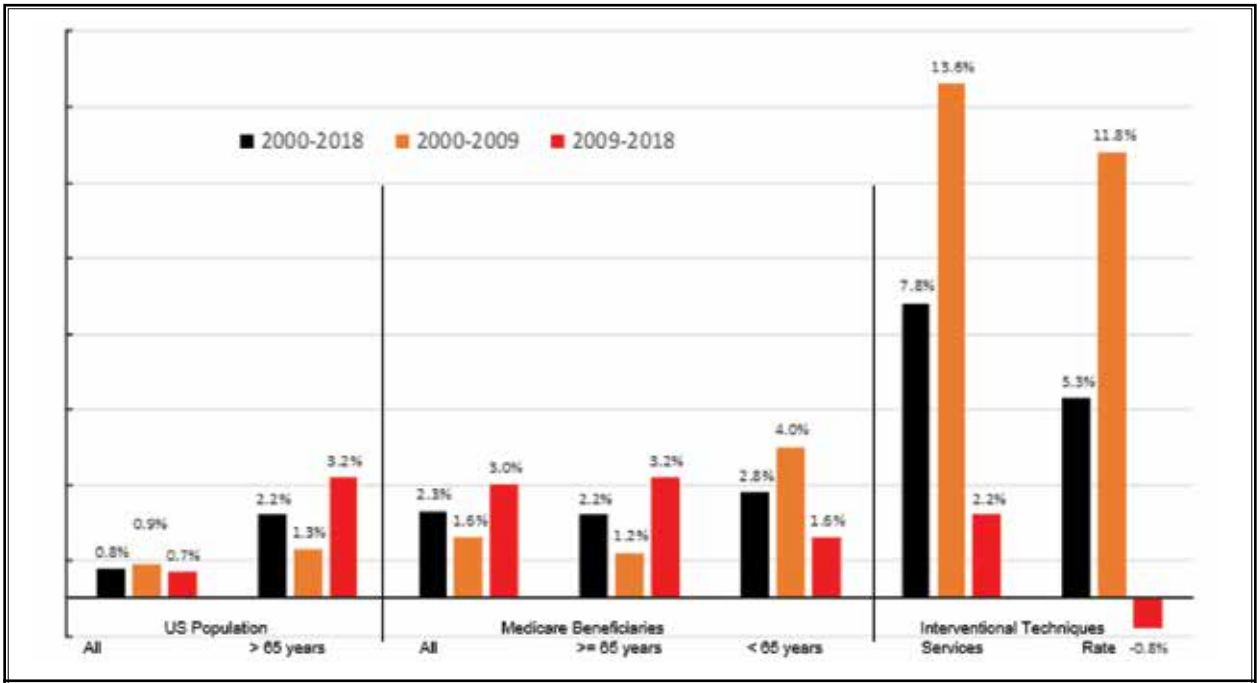

Fig. 1. *Comparative analysis of annual US population growth, Medicare participation, and utilization of interventional pain management services.*

Table 2. *The frequency of utilization of interventional techniques in the FFS Medicare population from 2000 to 2018.*

	Epidural and adhesiolysis procedures		Facet joint interventions and Sacroiliac joint blocks		Disc Procedures and other types of nerve blocks		Utilization of all interventional techniques*			
	Services (Facility %)	Rate	Services (Facility %)	*Rate*	Services (Facility%)	*Rate*	Services (Facility%)	*% of Change in services*	*Rate*	*% of Change in Rate*
2000	860,787 (79%)	*2,172*	424,796 (67%)	*1,072*	183,912 (87%)	*464*	1,469,495 (72%)		3,708	
2001	1,013,552 (78%)	*2,531*	543,509 (62%)	*1,357*	203,395 (87%)	*508*	1,760,456 (69%)	*19.8%*	*4,396*	18.6%

Table 2 (cont.). *The frequency of utilization of interventional techniques in the FFS Medicare population from 2000 to 2018.*

	Epidural and adhesiolysis procedures		Facet joint interventions and Sacroiliac joint blocks		Disc Procedures and other types of nerve blocks		Utilization of all interventional techniques*			
	Services (Facility %)	Rate	Services (Facility %)	*Rate*	Services (Facility%)	*Rate*	Services (Facility%)	*% of Change in services*	*Rate*	*% of Change in Rate*
2002	1,199,324 (74%)	*2,961*	708,186 (58%)	*1,748*	275,542 (81%)	*680*	2,183,052 (64%)	*24.0%*	*5,390*	22.6%
2003	1,370,862 (71%)	*3,333*	884,035 (53%)	*2,150*	304,426 (80%)	*740*	2,559,323 (60%)	*17.2%*	*6,223*	15.5%
2004	1,637,494 (65%)	*3,924*	1,354,242 (46%)	*3,245*	343,311 (79%)	*823*	3,335,047 (54%)	*30.3%*	*7,992*	28.4%
2005	1,776,153 (65%)	*4,180*	1,501,222 (47%)	*3,533*	383,324 (78%)	*902*	3,660,699 (54%)	*9.8%*	*8,614*	7.8%
2006	1,870,440 (63%)	*4,316*	1,896,688 (40%)	*4,376*	378,996 (75%)	*874*	4,146,124 (49%)	*13.3%*	*9,567*	11.1%
2007	1,940,454 (62%)	*4,384*	1,820,695 (46%)	*4,113*	349,978 (73%)	*791*	4,111,127 (52%)	*-0.8%*	*9,288*	-2.9%
2008	2,041,155 (61%)	*4,495*	1,974,999 (46%)	*4,349*	417,257 (70%	*919*	4,433,411 (51%)	*7.8%*	*9,763*	5.1%
2009	2,136,035 (59%)	*4,664*	2,111,700 (46%)	*4,611*	397,944 (69%)	*869*	4,645,679 (49%)	*4.8%*	*10,143*	3.9%
2010	2,226,486 (57%)	*4,746*	1,937,582 (48%)	*4,130*	414,909 (62%)	*884*	4,578,977 (52%)	*-1.4%*	*9,760*	-3.8%
2011	2,309,906 (58%)	*4,782*	2,064,227 (50%)	*4,274*	441,540 (61%)	*914*	4,815,673 (48%)	*5.2%*	*9,970*	2.2%
2012	2,324,563 (58%)	*4,621*	2,159,057 (50%)	*4,292*	464,354 (57%)	*923*	4,947,974 (53%)	*2.7%*	*9,837*	-1.3%
2013	2,278,790 (58%)	*4,391*	2,197,766 (51%)	*4,235*	456,394 (51%)	*879*	4,932,950 (53%)	*-0.3%*	*9,505*	-3.4%
2014	2,273,104 (57%)	*4,249*	2,370,000 (50%)	*4,430*	382,800 (47%)	*716*	5,025,904 (52%)	*1.9%*	*9,394*	-1.2%
2015	2,291,001 (57%)	*4,173*	2,568,428 (50%)	*4,678*	383,607 (44%)	*699*	5,243,036 (53%)	*4.3%*	*9,550*	1.7%
2016	2,329,062 (58%)	*4,122*	2,759,559 (52%)	*4,884*	420,685 (45%)	*745*	5,509,306 (54%)	*5.1%*	*9,751*	2.1%
2017	2,258,726 (54%)	*3,894*	2,862,876 (49%)	*4,936*	437,289 (43%)	*754*	5,558,893 (51%)	*0.9%*	*9,584*	-1.7%
2018	2,196,060 (54%)	*3,685*	2,970,100 (50%)	*4,983*	473,448 (44%)	*794*	5,639,608 (51%)	*1.5%*	*9,462*	-1.3%
Change from 2000 to 2018										
Change	155.1%	69.6%	599.2%	364.9%	157.4%	71.2%	283.8%		155.2%	
GM	5.3%	3.0%	11.4%	8.9%	5.4%	3.0%	7.8%		5.3%	
Change from 2000 to 2009										
Change	148.1%	114.7%	397.1%	330.2%	116.4%	87.2%	216.1%		173.6%	
GM	10.6%	8.9%	19.5%	17.6%	9.0%	7.2%	13.6%		11.8%	
Change from 2009 to 2018										
Change	2.8%	-21.0%	40.6%	8.1%	19.0%	-8.6%	21.4%		-6.7%	
GM	0.3%	-2.6%	3.9%	0.9%	1.9%	-1.0%	2.2%		-0.8%	

Rate= interventional pain management services per 100,000 Medicare Beneficiaries; GM= geometric average annual change; *(Excluding continuous epidurals, intraarticular injections, trigger point and ligament injections, peripheral nerve blocks, vertebral augmentation procedures, and implantables)

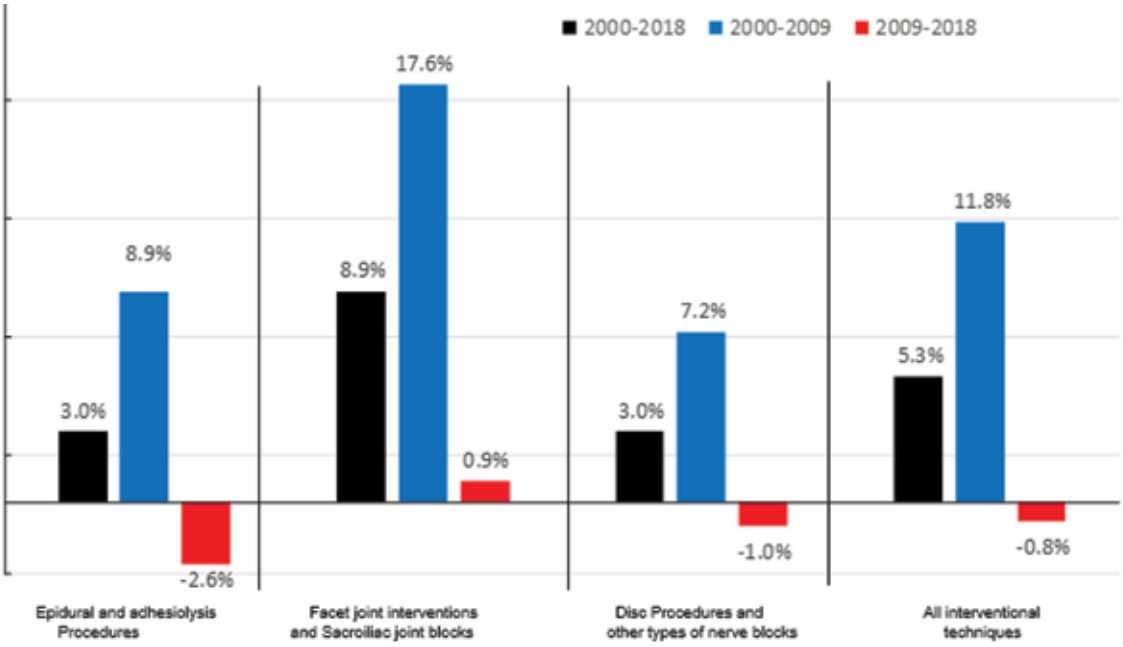

Fig. 2. *Comparative analysis of annual changes of epidural and adhesiolysis procedures, facet joint interventions and sacroiliac joint blocks, disc procedures and other types of nerve blocks, all interventional techniques.*

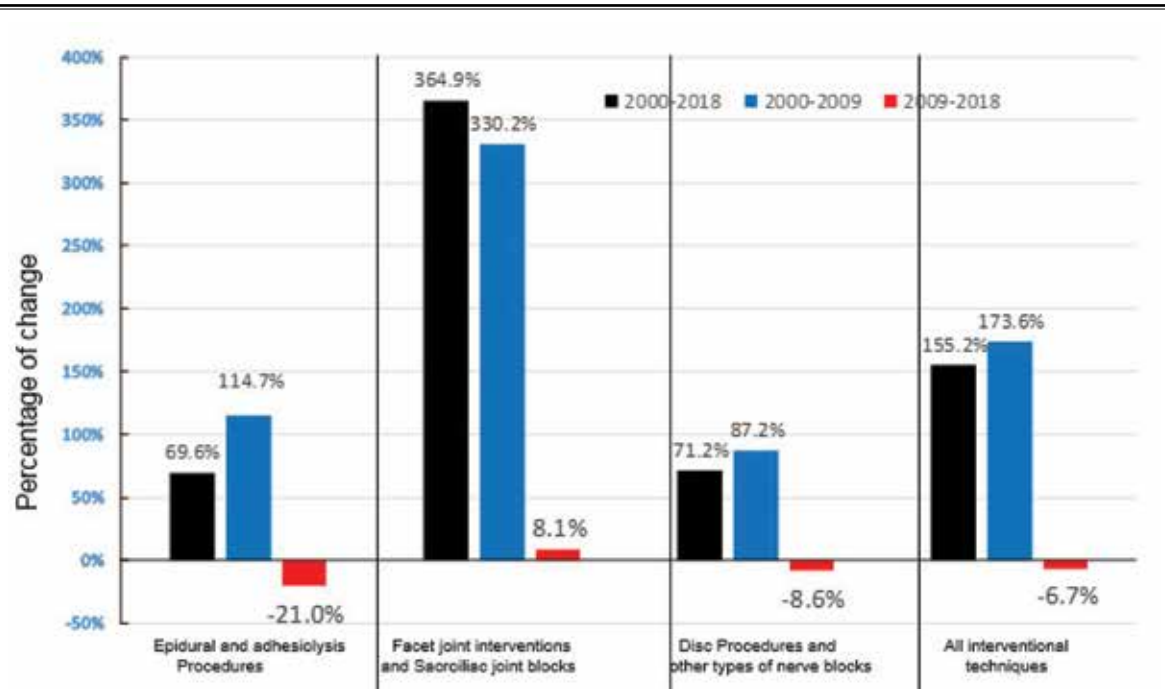

Fig. 3. *Comparative analysis of epidural and adhesiolysis procedures, facet joint interventions and sacroiliac joint blocks, disc procedures and other types of nerve blocks, all interventional techniques.*

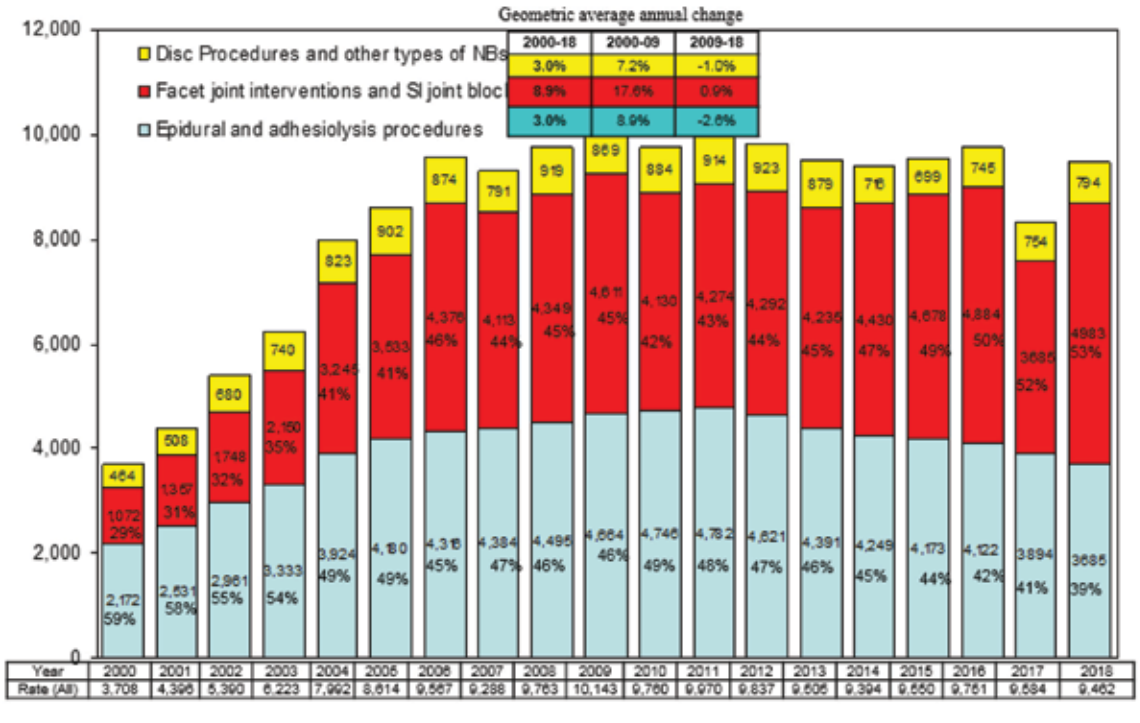

Fig. 4. *Distribution of procedural characteristics (rates) by type of procedures from 2000 to 2018.*

tional pain management techniques from 2009 to 2018 based on the rates of highest to lowest utilization as shown in Appendix Table 3. In addition, Appendix Table 4 shows highest to lowest based on proportion of change from 2009 to 2018 with Alaska showing the most increases, followed by Oklahoma, Utah, Delaware, whereas Rhode Island, followed by Tennessee, Michigan, Texas, and Alabama showing the most declines. Appendix Table 5 also shows percent of change in the services from 2009 to 2018 based on alphabetical order.

Site-of Service Characteristics

Interventional techniques are provided in multiple settings including hospital outpatient departments, ambulatory surgical centers, and in physician offices with resultant implications for payment. There has been a significant shift over the years in the performance of interventional techniques based on the location of the procedures performed, as shown in Fig. 5.

Services Compared to Rate

This manuscript provides both total number of services and rate per 100,000 population from 2000 to 2018 as shown in Fig. 6. Total number of services consistently continue to increase at a very slow pace, whereas rates of services per 100,000 Medicare population show slight declines starting in 2010.

Discussion

This updated assessment of utilization data of interventional techniques for chronic pain and the Medicare FFS population from 2000 to 2018 shows shifts from 2009 to 2018, compared to 2000 to 2009. These periods may be described as pre-ACA from 2000 to 2009 and post ACA from 2009 to 2018. Overall, interventional techniques declined at an annual rate of -0.8% from 2009 to 2018 compared to the US population growth increase of 0.7%, elderly of 3.2%, and Medicare population of 3%. The decline accelerated from -0.6% from 2009 to 2016 to -0.8% annual rate from 2009 to 2018 showing further declines in 2017 and 2018 compared to mild increases in 2015 and 2016 as shown in Table 1. This is in stark contrast to an annual increase of 11.8% from 2000 to 2009. However, of significant importance is the decline in the rate of epidural and adhesiolysis procedures of -2.6% annual rate compared to

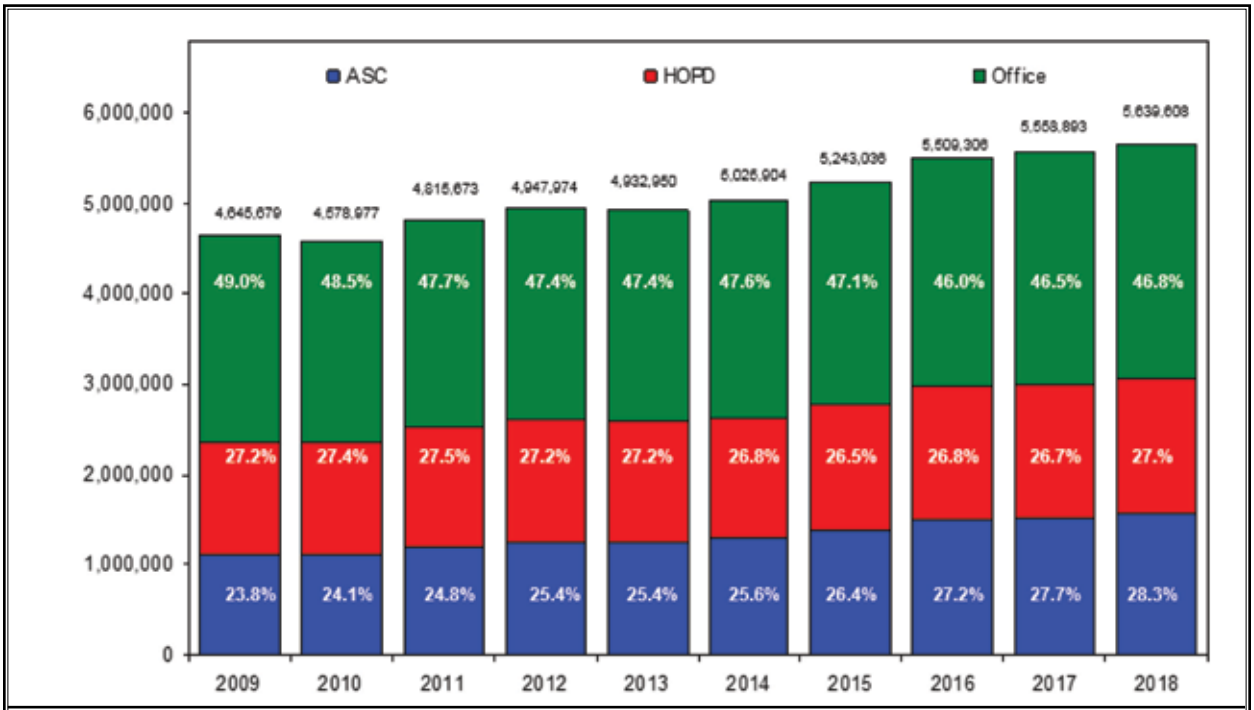

Fig. 5. *Utilization of interventional pain management techniques by place of service from 2009 to 2018, in Medicare recipients.*

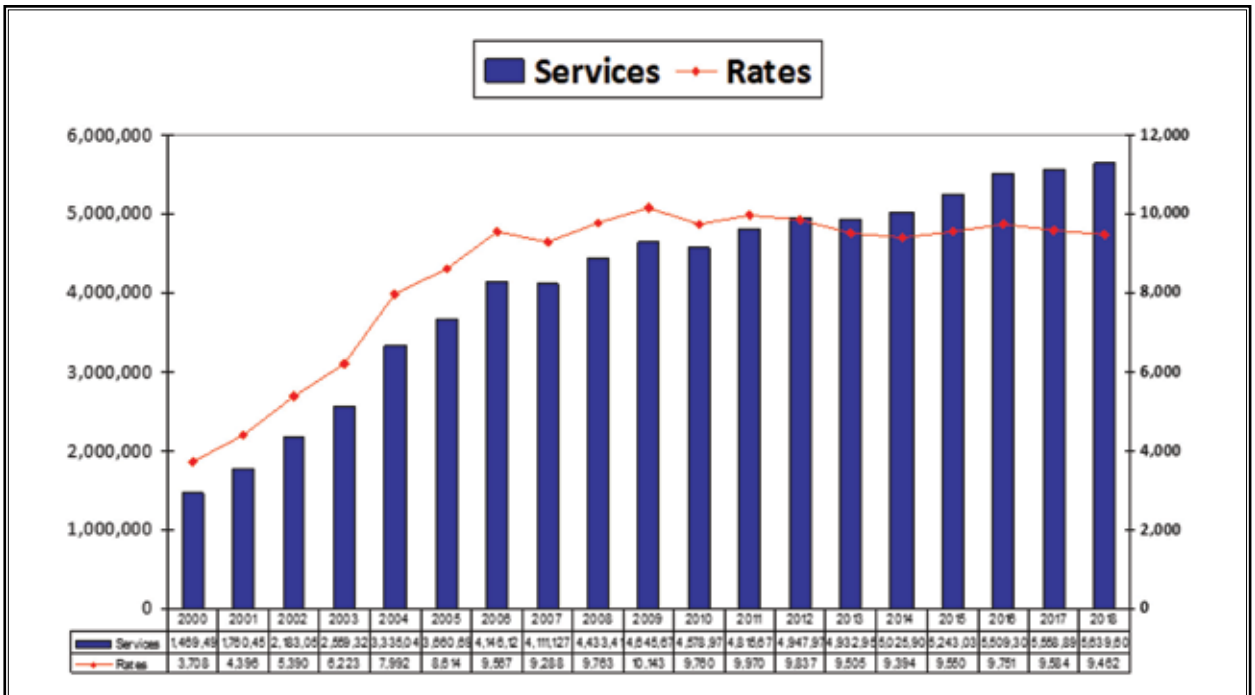

Fig. 6. *Utilization of interventional pain management techniques services & rates, in Medicare recipients.*

an annual increase of 8.9% from 2000 to 2009. Similar declines were also observed with disc procedures and other types of nerve blocks with an annual decline of -1% from 2009 to 2018 compared to a 7.2% increase from 2000 to 2009. Facet joint and sacroiliac joint interventions, in fact, was the only category with increases in utilization patterns of 0.9% annual rate from 2009 to 2018, whereas this annual rate of increase was 17.6% from 2000 to 2009. Overall, these findings confirm our findings from our previous publications (30-35) with continued decline and reversal of growth patterns.

Among the other data of this assessment, the US population growth decreased from an annual rate of 0.9% to 0.7% during the comparison periods of 2000 to 2009 and 2009 to 2018, whereas the US population over the age of 65 years increased at an annual rate of 1.3% and 3.2%, respectively. In addition, the number of individuals participating in Medicare also showed significant growth at an annual rate of 3% from 2009 to 2018, compared to 1.6% from 2000 to 2009. However, the enrollment of those individuals with disabilities below 65 years of age has declined to 1.6% of annual growth from 2009 to 2018, compared to 4% annual growth from 2000 to 2009.

This analysis once again reaches discordant conclusions compared to our own prior publications and publications by other authors (30-35,38,68,73), which continue to show increases. However, continuous data collection from prior years to the present will show increases as in this manuscript, due to extensive increases in earlier years. Consequently, separation of these 2 groups to pre and post-ACA before and after 2009 appropriately analyzes the results and removes the misconceptions. Overall, there have been significant increases of utilization of interventional techniques from 2000 to 2018 with 155.2% with an annual rate of 5.3%. However, all the increases were from 2000 to 2009 of 173.6% with an annual rate of 11.8%. The decline or reversal of growth patterns may be attributed to ACA enacted in 2010; a multitude of regulations focusing on decreasing utilization, increasing regulatory aspects that started in early 2009 with the passage of the Stimulus Act (74) and expanded with other regulations (5-8). In addition, as described in the above tables, the changes in coverage policies by Medicare carriers with modifications in LCDs, and reductions in reimbursement also have influenced utilization patterns (7,8,30-35,75-79). Thus, the changes may be related to reduced reimbursement and decreased access.

This updated analysis shows very similar results to our previous publications (30-35,70,80). However, they differ significantly from other evaluations (38,68,69,73). However, our results are in contrast to more recent publication by Starr et al (38). In that manuscript, the authors described trends in lumbar radiofrequency ablation utilization from 2007 to 2016 with inclusion of an explosive era of increase until 2009.

The present data continue to show increases in the elderly and Medicare populations. However, the population below the age of 65 appears to have been increasing at higher rates than in the elderly. There were no surprises in reference to utilization by states despite differences in policies developed by Noridian and notwithstanding allowed increased utilization rates in all states except Kentucky, Ohio, and Florida. Similar to interventional techniques, many other services also have seen changes in utilization. As an example, beginning in 2004, CMS implemented a series of reductions (81,82) in the physician fees for inpatient and outpatient testing and facility fees for cardiovascular diagnostic testing, due to significant geographic variations in use and expenses of these tests, and concern for potential overuse of these tests (83,84). In the face of these reimbursement changes, the overall rate of testing has modestly declined (85-87). Further, a recent analysis of trends in high- and low-value cardiovascular diagnostic testing from 2000 to 2016 showed considerable decline of overall and low-value diagnostic cardiovascular testing, whereas rates of high-value testing have increased slightly. Thus, payment changes intended to reduce spending on overall testing may not have adversely affected testing recommended by guidelines. However, analysis did not show the costs of the testing and shifting of services from office practices to hospital settings.

Limitations of the current study include its retrospective nature, the lack of differentiation of individual procedures in each category and the lack of inclusion of Medicare Advantage enrollees, which constitute approximately 30% of the Medicare population. Further, this analysis does not identify specific approaches with each modality of treatment in the various categories, such as facet joint nerve blocks versus radiofrequency neurotomy, and interlaminar epidural versus transforaminal epidural injections. We have analyzed these data elsewhere and showed significant differences in the growth patterns, with increases in utilization of transforaminal and facet joint neurolysis procedures (31-33).

Overall, since the previous publications, further

literature has been accumulating and the credibility of EBM, specifically its applications in dietary guidelines have brought various issues into focus, creating questions about the evidence synthesized by some authors with negative reviews on interventional pain management (40-45,47,48,50-60,88). Indeed, we believe that the literature shows that differences in conclusions may be based on investigator preference, lack of understanding of the basis of procedural aspects, lack of clinical experience, and conflicts of interest, and confluence of interest (89-95). The overall mass production of redundant, often misleading, and conflicted systematic reviews and meta-analyses (96), as well as the value and sustainability of EBM has been questioned (94,95). Consequently, RCTs, systematic reviews and guidelines may vary, and none of these manuscripts considered highly methodological do not guarantee corresponding methodological and reporting rigor (96-101).

The issues related to multiple publications on pain were highlighted by Riado Minguez et al (97), whereas Manchikanti et al (56) highlighted the effectiveness of percutaneous adhesiolysis in post lumbar surgery syndrome in a systematic analysis of findings of systematic reviews. Declines are not related to clinical effectiveness or cost effectiveness. Indeed, issues with EBM presented in numerous trials, systematic reviews, meta-analysis, as well as bias in reporting with inappropriate assessments have been noted by multiple authors, including Guyatt's group (96-110).

Conclusion

This analysis shows that from 2009 to 2018, not only was there a reversal of growth patterns of interventional pain procedures, but also actual declines in procedures, despite increases in the total US population, elderly population, and number of Medicare recipients.

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Appendix Figure

Appendix Table 1

Appendix Table 2

Appendix Table 3

Appendix Table 4

Appendix Table 5

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Appendix Table 1. Frequency of utilization of interventional pain management techniques from 2000 to 2018, in fee-for-service Medicare recipients.

Specialty	Interventional Pain Management #		Surgical (neuro, general, & orthopedic)		Radiology (interventional & diagnostic)		Other Physicians		Other Providers (CRNA, NP & PA)		Total	
	Services	Rate	Services	Rate	Services	Rate	Services	Rate	Services	Rate	Services*	Rate
2000	1,176,541 (80.1%)	2,969	92,126 (6.3%)	232	40,491 (2.8%)	102	145,100 (9.9%)	366	15,237 (1.0%)	38	1,469,495	3,708
2001	1,389,569 (78.9%)	3,470	105,075 (6.0%)	262	48,978 (2.8%)	122	196,311 (11.2%)	490	20,524 (1.2%)	51	1,760,456	4,396
2002	1,755,521 (80.4%)	4,334	123,403 (5.7%)	305	62,295 (2.9%)	154	218,870 (10.0%)	540	22,963 (1.1%)	57	2,183,052	5,390
2003	2,098,053 (82.0%)	5,102	133,165 (5.2%)	324	77,160 (3.0%)	188	229,010 (8.9%)	557	21,935 (0.9%)	53	2,559,323	6,223
2004	2,718,622 (81.5%)	6,515	168,669 (5.1%)	404	91,892 (2.8%)	220	329,705 (9.9%)	790	26,519 (0.8%)	64	3,335,047	7,992
2005	2,976,908 (81.3%)	7,005	183,972 (5.0%)	433	101,586 (2.8%)	239	367,303 (10.0%)	864	30,930 (0.8%)	73	3,660,699	8,614
2006	3,196,190 (77.1%)	7,375	211,580 (5.1%)	488	110,472 (2.7%)	255	589,835 (14.2%)	1361	38,047 (0.9%)	88	4,146,124	9,567
2007	3,405,892 (82.8%)	7,695	231,170 (5.6%)	522	111,423 (2.7%)	252	323,021 (7.9%)	730	39,621 (1.0%)	90	4,111,127	9,288
2008	3,670,828 (82.8%)	8,083	247,125 (5.6%)	544	117,388 (2.6%)	258	354,877 (8.0%)	781	43,193 (1.0%)	95	4,433,411	9,763
2009	3,879,520 (83.5%)	8,470	273,436 (5.9%)	597	123,228 (2.7%)	269	324,729 (7.0%)	709	44,766 (1.0%)	98	4,645,679	10,143
2010	3,917,426 (85.6%)	8,350	222,784 (4.9%)	475	121,127 (2.6%)	258	265,771 (5.8%)	567	51,869 (1.1%)	111	4,578,977	9,760
2011	4,159,585 (86.4%)	8,612	206,805 (4.3%)	428	127,614 (2.6%)	264	259,177 (5.4%)	537	62,492 (1.3%)	129	4,815,673	9,970
2012	4,302,121 (86.9%)	8,553	197,982 (4.0%)	394	129,823 (2.6%)	258	244,626 (4.9%)	486	73,422 (1.5%)	146	4,947,974	9,837
2013	4,331,789 (87.8%)	8,346	185,630 (3.8%)	358	119,172 (2.4%)	230	231,899 (4.7%)	447	64,460 (1.3%)	124	4,932,950	9,505
2014	4,467,374 (88.9%)	8,350	183,111 (3.6%)	342	119,684 (2.4%)	224	209,379 (4.2%)	391	46,356 (0.9%)	87	5,025,904	9,394
2015	4,693,156 (89.5%)	8,549	181,546 (3.5%)	331	121,344 (2.3%)	221	202,307 (3.9%)	369	44,683 (0.9%)	81	5,243,036	9550
2016	4,961,640 (90.1%)	8,782	179,880 (3.3%)	318	126,493 (2.3%)	224	189,573 (3.4%)	336	51,720 (0.9%)	92	5,509,306	9751
2017	5,038,383 (90.6%)	8,687	171,767 (3.1%)	296	129,098 (2.3%)	223	165,219 (3.0%)	285	54,426 (1.0%)	94	5,558,893	9584
2018	(91.1%)	8,620	174,072 (3.1%)	292	127,612 (2.3%)	214	137,855 (2.4%)	231	62,530 (1.1%)	105	5,639,608	9462
Change 2000-2018	336.7%	190.4%	88.9%	25.6%	215.2%	109.6%	-5.%	-36.8%	310.4%	172.9%	283.8%	155.2%
GM change	8.5%	6.1%	3.6%	1.3%	6.6%	4.2%	-0.3%	-2.5%	8.2%	5.7%	7.8%	5.3%
Change 2000-2009	229.7%	185.3%	196.8%	156.8%	204.3%	163.3%	123.8%	93.7%	193.8%	154.2%	216.1%	173.6%
GM	14.2%	12.4%	12.8%	11.%	13.2%	11.4%	9.4%	7.6%	12.7%	10.9%	13.6%	11.8%
Change 2009-2018	32.4%	1.8%	-36.3%	-51.1%	3.6%	-20.4%	-57.5%	-67.4%	39.7%	7.3%	21.4%	-6.7%
GM	3.2%	0.2%	-4.9%	-7.6%	0.4%	-2.5%	-9.1%	-11.7%	3.8%	0.8%	2.2%	-0.8%

Rate - IPM services per 100,000 Medicare Beneficiaries; ( ) percentage of row total
GM - Geometric average annual change

Appendix Table 2. *Rate (per 100,000 population) of utilization of interventional pain management techniques from 2009 to 2018, in fee-for-service Medicare recipients by 2018 Medicare Carrier contractors*

State	R2009	R2010	R2011	R2012	R2013	R2014	R2015	R2016	R2017	R2018	2009-18	GM
Cahaba												
Alabama	13,026	13,278	13,704	14,007	12,666	12,494	12,513	12,971	10,746	10,083	-22.6%	-2.8%
Georgia	14,447	12,889	13,799	13,786	12,574	12,459	12,965	12,940	12,729	12,268	-15.1%	-1.8%
Tennessee	12,482	12,030	12,844	12,987	10,165	8,548	8,541	8,996	8,958	8,420	-32.5%	-4.3%
Cahaba Total	13,398	12,704	13,452	13,577	11,788	11,157	11,369	11,639	10,977	10,445	-22.0%	-2.7%
CGS												
Kentucky	10,683	10,602	11,199	12,197	12,302	11,590	11,870	12,287	12,771	12,724	19.1%	2.0%
Ohio	9,420	9,176	9,156	9,364	9,138	8,806	8,462	9,282	8,937	8,441	-10.4%	-1.2%
CGS Total	9,779	9,583	9,741	10,177	10,050	9,608	9,443	10,142	10,029	9,659	-1.2%	-0.1%
First Coast												
Florida	16,071	14,175	14,188	14,104	13,237	13,194	13,264	13,612	12,640	12,660	-21.2%	-2.6%
NGS												
Connecticut	6,392	6,503	6,955	7,100	7,124	7,326	7,230	7,440	7,394	6,814	6.6%	0.7%
Illinois	9,607	8,807	8,898	9,308	9,044	8,715	8,844	8,992	8,923	8,682	-9.6%	-1.1%
Massachusetts	7,379	7,891	8,828	9,423	9,420	9,172	9,186	9,314	9,282	9,447	28.0%	2.8%
Maine	6,186	6,055	6,570	6,920	6,823	7,488	7,570	6,811	6,490	5,617	-9.2%	-1.1%
Minnesota	5,561	5,381	5,453	5,504	5,173	4,826	4,837	4,903	4,442	4,434	-20.3%	-2.5%
New Hampshire	10,014	11,096	11,853	11,846	11,027	10,092	9,613	9,104	8,738	8,423	-15.9%	-1.9%
New York	5,866	5,929	5,993	6,080	6,498	6,745	7,012	6,933	6,733	6,737	14.9%	1.6%
Rhode Island	7,021	7,665	7,471	6,502	5,420	5,392	5,562	5,309	4,556	4,624	-34.1%	-4.5%
Vermont	6,258	6,080	6,066	5,839	6,119	6,246	6,638	6,429	6,414	5,904	-5.7%	-0.6%
Wisconsin	7,697	7,593	7,944	8,151	7,889	7,459	7,236	7,328	6,896	6,868	-10.8%	-1.3%
NGS Total	7,151	7,082	7,335	7,542	7,529	7,447	7,531	7,543	7,331	7,221	1.0%	0.1%
Noridian												
Alaska	5,342	5,686	5,627	5,478	6,389	6,721	8,809	8,117	7,508	8,319	55.7%	5.0%
Arizona	11,267	11,906	12,627	12,950	13,152	13,414	13,525	14,077	14,054	14,899	32.2%	3.2%
California	8,022	7,733	7,826	7,824	7,711	7,173	7,109	6,989	6,630	6,571	-18.1%	-2.2%
Idaho	7,407	7,187	7,829	7,599	7,537	7,839	8,239	7,807	7,466	8,114	9.6%	1.0%
Montana	7,600	6,647	7,276	7,050	6,979	6,842	7,047	6,955	6,657	7,009	-7.8%	-0.9%
North Dakota	8,124	7,681	6,961	7,110	7,452	7,603	7,378	7,639	8,110	7,986	-1.7%	-0.2%
Nevada	10,506	11,541	12,062	12,761	12,451	12,004	12,857	12,276	11,383	11,981	14.0%	1.5%
Oregon	4,228	4,271	4,448	4,587	4,804	4,612	4,755	4,822	4,517	4,774	12.9%	1.4%
South Dakota	11,980	10,233	10,006	9,106	9,220	8,843	9,007	9,111	9,329	9,949	-17.0%	-2.0%
Utah	11,133	11,430	11,897	13,446	13,843	14,834	15,914	16,177	15,427	16,145	45.0%	4.2%
Washington	6,164	5,958	5,787	5,318	5,341	4,985	4,926	5,009	5,148	5,274	-14.4%	-1.7%
Wyoming	7,071	7,423	6,569	6,687	7,557	8,016	8,047	8,452	8,120	7,743	9.5%	1.0%
Noridian Total	8,104	7,994	8,163	8,209	8,211	7,923	8,014	7,992	7,729	7,918	-2.3%	-0.3%
Novitas												
Arkansas	12,978	12,319	11,130	11,269	11,654	12,246	13,462	15,005	15,662	16,534	27.4%	2.7%
Colorado	7,218	7,465	7,800	8,439	8,469	8,655	8,778	9,420	9,344	9,593	32.9%	3.2%
DC	50,647	52,070	57,626	57,006	71,556	75,143	81,035	76,031	74,932	74,160	46.4%	4.3%
Delaware	9,341	9,169	9,479	9,741	10,457	11,203	12,217	12,635	11,659	12,536	34.2%	3.3%
Louisiana	10,800	10,654	11,289	11,701	12,175	12,161	12,195	12,244	12,059	11,521	6.7%	0.7%

Appendix Table 2 (cont.). *Rate (per 100,000 population) of utilization of interventional pain management techniques from 2009 to 2018, in fee-for-service Medicare recipients by 2018 Medicare Carrier contractors*

State	R2009	R2010	R2011	R2012	R2013	R2014	R2015	R2016	R2017	R2018	2009-18	GM
Maryland	9,213	8,798	9,619	9,639	10,384	10,941	11,391	10,767	9,828	10,053	9.1%	1.0%
Mississippi	12,668	11,957	12,422	12,799	12,545	11,760	12,492	12,952	12,784	12,601	-0.5%	-0.1%
New Jersey	7,446	7,577	7,924	7,841	8,580	8,635	9,115	9,415	8,662	8,604	15.6%	1.6%
New Mexico	6,420	6,525	6,886	7,039	6,761	6,579	6,726	6,548	6,969	7,250	12.9%	1.4%
Oklahoma	9,923	9,862	10,561	11,055	11,356	12,511	14,052	13,671	14,843	14,846	49.6%	4.6%
Pennsylvania	6,878	7,075	7,298	7,409	7,791	7,868	7,776	7,911	7,681	7,576	10.2%	1.1%
Texas	16,025	13,916	13,839	12,916	12,214	12,291	12,607	12,957	12,142	11,690	-27.1%	-3.4%
Novitas Total	10,952	10,366	10,622	10,502	10,654	10,834	11,237	11,497	11,102	10,989	0.3%	0.0%
Palmetto GBA												
North Carolina	10,677	10,265	10,448	10,613	9,977	9,274	9,618	10,150	10,174	9,943	-6.9%	-0.8%
South Carolina	12,800	13,018	13,756	14,276	14,423	14,399	14,622	14,348	14,028	13,732	7.3%	0.8%
Virginia	7,259	6,873	7,307	7,361	7,837	8,335	8,729	8,971	8,917	8,969	23.6%	2.4%
West Virginia	6,475	6,747	7,115	7,742	8,082	7,886	7,384	8,118	7,934	6,767	4.5%	0.5%
Palmetto Total	9,648	9,451	9,850	10,103	10,098	9,947	10,209	10,488	10,411	10,175	5.5%	0.6%
WPS												
Iowa	6,025	6,061	6,405	6,415	6,317	6,027	6,440	6,866	6,482	6,502	7.9%	0.9%
Indiana	11,191	11,484	12,158	12,278	11,607	11,819	12,202	12,232	11,216	11,011	-1.6%	-0.2%
Kansas	10,747	10,819	11,306	11,113	11,013	10,968	11,092	10,882	10,620	11,034	2.7%	0.3%
Michigan	14,822	14,915	14,751	14,660	14,309	14,332	13,898	12,899	11,078	10,014	-32.4%	-4.3%
Missouri	12,001	11,874	12,112	12,205	11,581	11,767	11,211	10,920	10,609	10,602	-11.7%	-1.4%
Nebraska	8,013	7,535	7,471	7,770	7,624	7,786	7,965	8,452	8,265	8,998	12.3%	1.3%
WPS Total	11,806	11,864	12,083	12,103	11,711	11,778	11,658	11,307	10,338	10,010	-15.2%	-1.8%
US Total	10,143	9,760	9,970	9,837	9,505	9,394	9,550	9,751	9,584	9,462	-6.7%	-0.8%

The US total included DC, Hawaii/Guam, Puerto Rico/Virgin Islands, and Railroad FFS Medicare data, but the state data included only FFS Medicare

Appendix Table 3. Rate of utilization of interventional pain management techniques from 2009 to 2018, in fee-for-service Medicare recipients based on 2018 rate highest to lowest.

State	R2009	R2010	R2011	R2012	R2013	R2014	R2015	R2016	R2017	R2018	Change*	GM
Arkansas	12,978	12,319	11,130	11,269	11,654	12,246	13,462	15,005	15,662	16,534	27.4%	2.7%
Utah	11,133	11,430	11,897	13,446	13,843	14,834	15,914	16,177	15,427	16,145	45.0%	4.2%
Arizona	11,267	11,906	12,627	12,950	13,152	13,414	13,525	14,077	14,054	14,899	32.2%	3.2%
Oklahoma	9,923	9,862	10,561	11,055	11,356	12,511	14,052	13,671	14,843	14,846	49.6%	4.6%
South Carolina	12,800	13,018	13,756	14,276	14,423	14,399	14,622	14,348	14,028	13,732	7.3%	0.8%
Kentucky	10,683	10,602	11,199	12,197	12,302	11,590	11,870	12,287	12,771	12,724	19.1%	2.0%
Florida	16,071	14,175	14,188	14,104	13,237	13,194	13,264	13,612	12,640	12,660	-21.2%	-2.6%
Mississippi	12,668	11,957	12,422	12,799	12,545	11,760	12,492	12,952	12,784	12,601	-0.5%	-0.1%
Delaware	9,341	9,169	9,479	9,741	10,457	11,203	12,217	12,635	11,659	12,536	34.2%	3.3%
Georgia	14,447	12,889	13,799	13,786	12,574	12,459	12,965	12,940	12,729	12,268	-15.1%	-1.8%
Nevada	10,506	11,541	12,062	12,761	12,451	12,004	12,857	12,276	11,383	11,981	14.0%	1.5%
Texas	16,025	13,916	13,839	12,916	12,214	12,291	12,607	12,957	12,142	11,690	-27.1%	-3.4%
Louisiana	10,800	10,654	11,289	11,701	12,175	12,161	12,195	12,244	12,059	11,521	6.7%	0.7%
Kansas	10,747	10,819	11,306	11,113	11,013	10,968	11,092	10,882	10,620	11,034	2.7%	0.3%
Indiana	11,191	11,484	12,158	12,278	11,607	11,819	12,202	12,232	11,216	11,011	-1.6%	-0.2%
Missouri	12,001	11,874	12,112	12,205	11,581	11,767	11,211	10,920	10,609	10,602	-11.7%	-1.4%
Alabama	13,026	13,278	13,704	14,007	12,666	12,494	12,513	12,971	10,746	10,083	-22.6%	-2.8%
Maryland	9,213	8,798	9,619	9,639	10,384	10,941	11,391	10,767	9,828	10,053	9.1%	1.0%
Michigan	14,822	14,915	14,751	14,660	14,309	14,332	13,898	12,899	11,078	10,014	-32.4%	-4.3%
South Dakota	11,980	10,233	10,006	9,106	9,220	8,843	9,007	9,111	9,329	9,949	-17.0%	-2.0%
North Carolina	10,677	10,265	10,448	10,613	9,977	9,274	9,618	10,150	10,174	9,943	-6.9%	-0.8%
Colorado	7,218	7,465	7,800	8,439	8,469	8,655	8,778	9,420	9,344	9,593	32.9%	3.2%
Massachusetts	7,379	7,891	8,828	9,423	9,420	9,172	9,186	9,314	9,282	9,447	28.0%	2.8%
Nebraska	8,013	7,535	7,471	7,770	7,624	7,786	7,965	8,452	8,265	8,998	12.3%	1.3%
Virginia	7,259	6,873	7,307	7,361	7,837	8,335	8,729	8,971	8,917	8,969	23.6%	2.4%
Illinois	9,607	8,807	8,898	9,308	9,044	8,715	8,844	8,992	8,923	8,682	-9.6%	-1.1%
New Jersey	7,446	7,577	7,924	7,841	8,580	8,635	9,115	9,415	8,662	8,604	15.6%	1.6%
Ohio	9,420	9,176	9,156	9,364	9,138	8,806	8,462	9,282	8,937	8,441	-10.4%	-1.2%
New Hampshire	10,014	11,096	11,853	11,846	11,027	10,092	9,613	9,104	8,738	8,423	-15.9%	-1.9%
Tennessee	12,482	12,030	12,844	12,987	10,165	8,548	8,541	8,996	8,958	8,420	-32.5%	-4.3%
Alaska	5,342	5,686	5,627	5,478	6,389	6,721	8,809	8,117	7,508	8,319	55.7%	5.0%
Idaho	7,407	7,187	7,829	7,599	7,537	7,839	8,239	7,807	7,466	8,114	9.6%	1.0%
North Dakota	8,124	7,681	6,961	7,110	7,452	7,603	7,378	7,639	8,110	7,986	-1.7%	-0.2%
Wyoming	7,071	7,423	6,569	6,687	7,557	8,016	8,047	8,452	8,120	7,743	9.5%	1.0%
Pennsylvania	6,878	7,075	7,298	7,409	7,791	7,868	7,776	7,911	7,681	7,576	10.2%	1.1%
New Mexico	6,420	6,525	6,886	7,039	6,761	6,579	6,726	6,548	6,969	7,250	12.9%	1.4%
Montana	7,600	6,647	7,276	7,050	6,979	6,842	7,047	6,955	6,657	7,009	-7.8%	-0.9%
Wisconsin	7,697	7,593	7,944	8,151	7,889	7,459	7,236	7,328	6,896	6,868	-10.8%	-1.3%
Connecticut	6,392	6,503	6,955	7,100	7,124	7,326	7,230	7,440	7,394	6,814	6.6%	0.7%
West Virginia	6,475	6,747	7,115	7,742	8,082	7,886	7,384	8,118	7,934	6,767	4.5%	0.5%
New York	5,866	5,929	5,993	6,080	6,498	6,745	7,012	6,933	6,733	6,737	14.9%	1.6%
California	8,022	7,733	7,826	7,824	7,711	7,173	7,109	6,989	6,630	6,571	-18.1%	-2.2%
Iowa	6,025	6,061	6,405	6,415	6,317	6,027	6,440	6,866	6,482	6,502	7.9%	0.9%
Vermont	6,258	6,080	6,066	5,839	6,119	6,246	6,638	6,429	6,414	5,904	-5.7%	-0.6%

Appendix Table 3 (cont.). Rate of utilization of interventional pain management techniques from 2009 to 2018, in fee-for-service Medicare recipients based on 2018 rate highest to lowest.

Maine	6,186	6,055	6,570	6,920	6,823	7,488	7,570	6,811	6,490	5,617	-9.2%	-1.1%
Washington	6,164	5,958	5,787	5,318	5,341	4,985	4,926	5,009	5,148	5,274	-14.4%	-1.7%
Oregon	4,228	4,271	4,448	4,587	4,804	4,612	4,755	4,822	4,517	4,774	12.9%	1.4%
Rhode Island	7,021	7,665	7,471	6,502	5,420	5,392	5,562	5,309	4,556	4,624	-34.1%	-4.5%
Minnesota	5,561	5,381	5,453	5,504	5,173	4,826	4,837	4,903	4,442	4,434	-20.3%	-2.5%
US Total	10,143	9,760	9,970	9,837	9,505	9,394	9,550	9,751	9,584	9,462	-6.7%	-0.8%

GM = Geometric Average Change
* Change: % of change from 2018 to 2009
US total included, DC Hawaii/Guam, Puerto Rico/Virgin Island and Railroad Medicare data.

Appendix Table 4. Rate of utilization of interventional pain management techniques from 2009 to 2018, in fee-for-service Medicare recipients by percentage of change from 2009 to 2018 highest to lowest.

State	R2009	R2010	R2011	R2012	R2013	R2014	R2015	R2016	R2017	R2018	Change*	GM
Alaska	5,342	5,686	5,627	5,478	6,389	6,721	8,809	8,117	7,508	8,319	55.7%	5.0%
Oklahoma	9,923	9,862	10,561	11,055	11,356	12,511	14,052	13,671	14,843	14,846	49.6%	4.6%
Utah	11,133	11,430	11,897	13,446	13,843	14,834	15,914	16,177	15,427	16,145	45.0%	4.2%
Delaware	9,341	9,169	9,479	9,741	10,457	11,203	12,217	12,635	11,659	12,536	34.2%	3.3%
Colorado	7,218	7,465	7,800	8,439	8,469	8,655	8,778	9,420	9,344	9,593	32.9%	3.2%
Arizona	11,267	11,906	12,627	12,950	13,152	13,414	13,525	14,077	14,054	14,899	32.2%	3.2%
Massachusetts	7,379	7,891	8,828	9,423	9,420	9,172	9,186	9,314	9,282	9,447	28.0%	2.8%
Arkansas	12,978	12,319	11,130	11,269	11,654	12,246	13,462	15,005	15,662	16,534	27.4%	2.7%
Virginia	7,259	6,873	7,307	7,361	7,837	8,335	8,729	8,971	8,917	8,969	23.6%	2.4%
Kentucky	10,683	10,602	11,199	12,197	12,302	11,590	11,870	12,287	12,771	12,724	19.1%	2.0%
New Jersey	7,446	7,577	7,924	7,841	8,580	8,635	9,115	9,415	8,662	8,604	15.6%	1.6%
New York	5,866	5,929	5,993	6,080	6,498	6,745	7,012	6,933	6,733	6,737	14.9%	1.6%
Nevada	10,506	11,541	12,062	12,761	12,451	12,004	12,857	12,276	11,383	11,981	14.0%	1.5%
New Mexico	6,420	6,525	6,886	7,039	6,761	6,579	6,726	6,548	6,969	7,250	12.9%	1.4%
Oregon	4,228	4,271	4,448	4,587	4,804	4,612	4,755	4,822	4,517	4,774	12.9%	1.4%
Nebraska	8,013	7,535	7,471	7,770	7,624	7,786	7,965	8,452	8,265	8,998	12.3%	1.3%
Pennsylvania	6,878	7,075	7,298	7,409	7,791	7,868	7,776	7,911	7,681	7,576	10.2%	1.1%
Idaho	7,407	7,187	7,829	7,599	7,537	7,839	8,239	7,807	7,466	8,114	9.6%	1.0%
Wyoming	7,071	7,423	6,569	6,687	7,557	8,016	8,047	8,452	8,120	7,743	9.5%	1.0%
Maryland	9,213	8,798	9,619	9,639	10,384	10,941	11,391	10,767	9,828	10,053	9.1%	1.0%
Iowa	6,025	6,061	6,405	6,415	6,317	6,027	6,440	6,866	6,482	6,502	7.9%	0.9%
South Carolina	12,800	13,018	13,756	14,276	14,423	14,399	14,622	14,348	14,028	13,732	7.3%	0.8%
Louisiana	10,800	10,654	11,289	11,701	12,175	12,161	12,195	12,244	12,059	11,521	6.7%	0.7%
Connecticut	6,392	6,503	6,955	7,100	7,124	7,326	7,230	7,440	7,394	6,814	6.6%	0.7%
West Virginia	6,475	6,747	7,115	7,742	8,082	7,886	7,384	8,118	7,934	6,767	4.5%	0.5%
Kansas	10,747	10,819	11,306	11,113	11,013	10,968	11,092	10,882	10,620	11,034	2.7%	0.3%
Mississippi	12,668	11,957	12,422	12,799	12,545	11,760	12,492	12,952	12,784	12,601	-0.5%	-0.1%
Indiana	11,191	11,484	12,158	12,278	11,607	11,819	12,202	12,232	11,216	11,011	-1.6%	-0.2%
North Dakota	8,124	7,681	6,961	7,110	7,452	7,603	7,378	7,639	8,110	7,986	-1.7%	-0.2%
Vermont	6,258	6,080	6,066	5,839	6,119	6,246	6,638	6,429	6,414	5,904	-5.7%	-0.6%
North Carolina	10,677	10,265	10,448	10,613	9,977	9,274	9,618	10,150	10,174	9,943	-6.9%	-0.8%
Montana	7,600	6,647	7,276	7,050	6,979	6,842	7,047	6,955	6,657	7,009	-7.8%	-0.9%
Maine	6,186	6,055	6,570	6,920	6,823	7,488	7,570	6,811	6,490	5,617	-9.2%	-1.1%
Illinois	9,607	8,807	8,898	9,308	9,044	8,715	8,844	8,992	8,923	8,682	-9.6%	-1.1%
Ohio	9,420	9,176	9,156	9,364	9,138	8,806	8,462	9,282	8,937	8,441	-10.4%	-1.2%
Wisconsin	7,697	7,593	7,944	8,151	7,889	7,459	7,236	7,328	6,896	6,868	-10.8%	-1.3%
Missouri	12,001	11,874	12,112	12,205	11,581	11,767	11,211	10,920	10,609	10,602	-11.7%	-1.4%
Washington	6,164	5,958	5,787	5,318	5,341	4,985	4,926	5,009	5,148	5,274	-14.4%	-1.7%
Georgia	14,447	12,889	13,799	13,786	12,574	12,459	12,965	12,940	12,729	12,268	-15.1%	-1.8%
New Hampshire	10,014	11,096	11,853	11,846	11,027	10,092	9,613	9,104	8,738	8,423	-15.9%	-1.9%
South Dakota	11,980	10,233	10,006	9,106	9,220	8,843	9,007	9,111	9,329	9,949	-17.0%	-2.0%
California	8,022	7,733	7,826	7,824	7,711	7,173	7,109	6,989	6,630	6,571	-18.1%	-2.2%
Minnesota	5,561	5,381	5,453	5,504	5,173	4,826	4,837	4,903	4,442	4,434	-20.3%	-2.5%
Florida	16,071	14,175	14,188	14,104	13,237	13,194	13,264	13,612	12,640	12,660	-21.2%	-2.6%
Alabama	13,026	13,278	13,704	14,007	12,666	12,494	12,513	12,971	10,746	10,083	-22.6%	-2.8%

Appendix Table 4 (cont.). Rate of utilization of interventional pain management techniques from 2009 to 2018, in fee-for-service Medicare recipients by percentage of change from 2009 to 2018 highest to lowest.

State	R2009	R2010	R2011	R2012	R2013	R2014	R2015	R2016	R2017	R2018	Change*	GM
Texas	16,025	13,916	13,839	12,916	12,214	12,291	12,607	12,957	12,142	11,690	-27.1%	-3.4%
Michigan	14,822	14,915	14,751	14,660	14,309	14,332	13,898	12,899	11,078	10,014	-32.4%	-4.3%
Tennessee	12,482	12,030	12,844	12,987	10,165	8,548	8,541	8,996	8,958	8,420	-32.5%	-4.3%
Rhode Island	7,021	7,665	7,471	6,502	5,420	5,392	5,562	5,309	4,556	4,624	-34.1%	-4.5%
US Total	10,143	9,760	9,970	9,837	9,505	9,394	9,550	9,751	9,584	9,462	-6.7%	-0.8%

GM = Geometric Average Change

* Change: % of change from 2018 to 2009

US total included DC, Hawaii/Guam, Puerto Rico/Virgin Island and Railroad Medicare data.

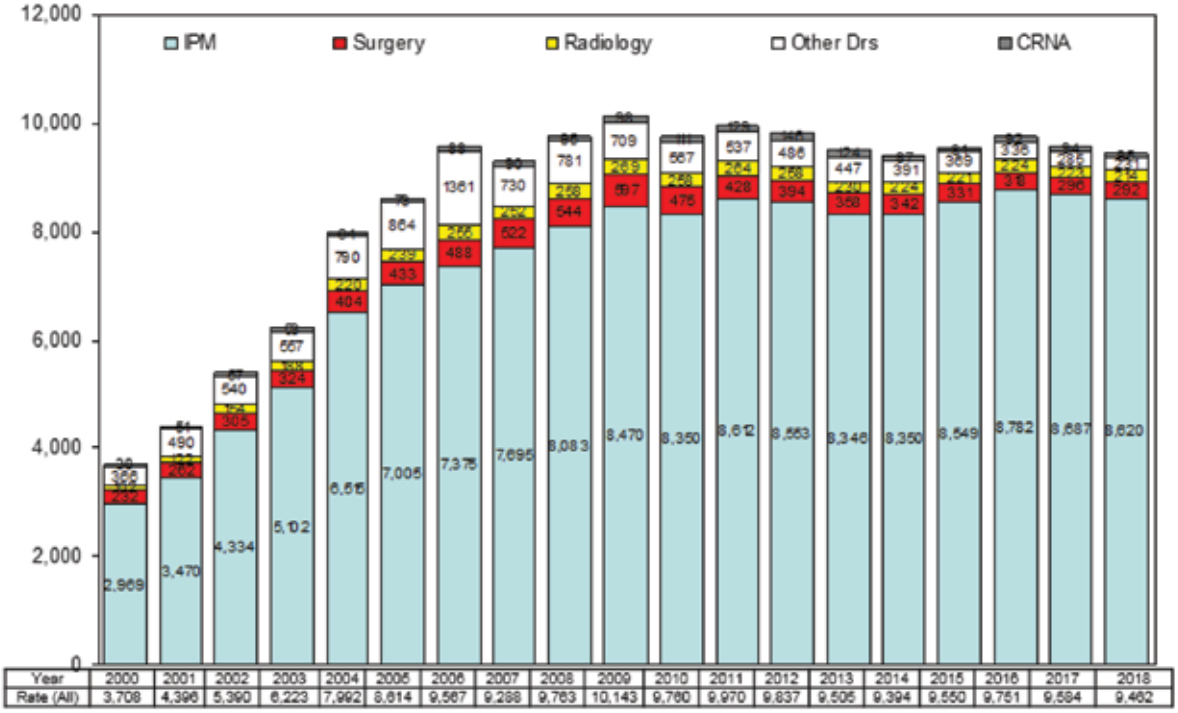
Appendix Table 5. Utilization of interventional pain management techniques (services) from 2009 to 2018, in fee-for-service Medicare recipients by percentage of change from 2009 to 2018 in alphabetical order

State	S2009	S2010	S2011	S2012	S2013	S2014	S2015	S2016	S2017	S2018	Change	GM
Alaska	3,350	3,735	3,875	3,796	4,527	4,958	6,807	6,807	6,898	8,005	139.0%	10.2%
Alabama	107,803	112,238	118,426	123,502	114,830	116,211	118,975	125,559	108,259	103,616	-3.9%	-0.4%
Arkansas	67,532	65,463	60,309	62,249	65,747	70,538	78,919	89,221	96,515	103,784	53.7%	4.9%
Arizona	101,349	110,753	121,518	126,582	132,536	140,830	147,800	159,741	172,394	189,437	86.9%	7.2%
California	370,589	367,886	383,499	391,227	380,778	366,628	375,244	394,511	395,535	402,468	8.6%	0.9%
Colorado	43,451	46,640	50,671	56,313	58,039	62,068	65,622	73,981	79,206	84,527	94.5%	7.7%
Connecticut	35,674	36,907	40,121	41,643	40,719	42,693	42,834	46,897	48,412	45,502	27.5%	2.7%
DC	38,843	40,684	45,971	46,323	50,975	54,645	60,192	67,227	68,226	68,635	76.7%	6.5%
Delaware	13,551	13,688	14,570	15,321	17,015	18,957	21,450	22,809	22,570	25,212	86.1%	7.1%
Florida	528,578	478,339	492,603	497,578	488,013	504,527	525,382	547,769	542,904	558,700	5.7%	0.6%
Georgia	172,477	159,269	176,695	181,802	172,141	177,531	191,218	196,621	206,730	205,651	19.2%	2.0%
Iowa	30,823	31,362	33,494	34,079	34,210	33,314	36,287	39,269	38,771	39,821	29.2%	2.9%
Idaho	16,440	16,515	18,598	18,458	19,251	20,869	22,841	22,019	22,874	25,984	58.1%	5.2%
Illinois	173,545	161,986	166,568	177,591	170,451	167,899	173,846	185,808	191,817	190,454	9.7%	1.0%
Indiana	110,244	115,501	124,851	128,730	125,191	130,783	138,235	140,736	135,137	135,857	23.2%	2.3%
Kansas	45,723	46,819	49,668	49,811	49,928	50,920	52,545	53,006	54,152	57,725	26.2%	2.6%
Kentucky	79,420	80,572	86,994	96,759	99,623	95,948	100,177	106,023	114,420	116,118	46.2%	4.3%
Louisiana	72,502	73,165	79,347	84,015	89,255	91,548	94,071	97,115	99,932	97,817	34.9%	3.4%
Massachusetts	76,689	83,727	95,756	104,076	102,600	102,550	105,160	113,443	118,393	123,266	60.7%	5.4%
Maryland	70,395	69,045	77,639	79,752	83,935	91,092	97,611	100,138	96,706	101,698	44.5%	4.2%
Maine	16,027	16,038	17,787	19,132	19,288	21,777	22,558	20,870	20,908	18,607	16.1%	1.7%
Michigan	239,311	246,277	249,181	253,379	257,314	263,925	261,396	244,517	219,509	202,741	-15.3%	-1.8%
Minnesota	42,640	42,286	43,821	45,126	43,456	41,735	43,031	44,725	42,967	44,179	3.6%	0.4%
Missouri	118,244	119,255	123,810	126,995	122,997	127,981	124,628	124,095	125,503	127,738	8.0%	0.9%
Mississippi	61,818	59,445	62,933	66,145	66,784	64,026	69,364	72,574	74,148	74,472	20.5%	2.1%
Montana	12,512	11,267	12,635	12,538	12,876	13,028	13,859	14,004	14,345	15,635	25.0%	2.5%
North Carolina	154,602	152,928	160,194	166,460	164,629	158,076	168,722	179,554	191,010	192,124	24.3%	2.4%
North Dakota	8,774	8,396	7,662	7,880	8,293	8,600	8,506	9,081	10,063	10,197	16.2%	1.7%
Nebraska	22,084	21,027	21,115	22,345	22,059	23,036	24,187	26,515	27,231	30,415	37.7%	3.6%
New Hampshire	21,768	24,772	27,140	27,418	25,789	24,496	24,060	24,236	24,554	24,442	12.3%	1.3%
New Jersey	97,114	100,544	107,106	108,064	115,272	118,403	127,430	140,475	134,549	136,374	40.4%	3.8%
New Mexico	19,505	20,452	22,207	23,228	22,420	22,571	23,843	24,404	27,662	29,716	52.4%	4.8%
Nevada	36,037	41,158	44,846	48,474	48,686	49,186	55,209	55,613	56,043	61,311	70.1%	6.1%
New York	172,293	177,175	182,256	188,076	196,857	208,871	221,225	231,810	234,442	239,838	39.2%	3.7%
Ohio	176,186	174,392	177,025	184,597	182,703	180,261	176,889	199,972	200,988	193,745	10.0%	1.1%
Oklahoma	58,726	59,513	64,919	69,193	72,103	81,026	92,720	103,137	104,840	107,270	82.7%	6.9%
Oregon	25,462	26,526	28,487	29,994	32,596	32,586	34,897	36,375	36,481	39,960	56.9%	5.1%
Pennsylvania	154,898	161,548	168,720	174,152	183,675	189,194	190,518	200,426	201,981	203,323	31.3%	3.1%
Rhode Island	12,654	14,024	13,868	12,256	9,856	10,025	10,567	10,793	9,644	10,003	-20.9%	-2.6%
South Carolina	95,828	100,722	109,971	117,202	124,582	129,050	135,748	135,041	141,176	142,878	49.1%	4.5%

Appendix Table 5 (cont.). Utilization of interventional pain management techniques (services) from 2009 to 2018, in fee-for-service Medicare recipients by percentage of change from 2009 to 2018 in alphabetical order.

State	S2009	S2010	S2011	S2012	S2013	S2014	S2015	S2016	S2017	S2018	Change	GM
South Dakota	16,110	13,975	13,867	12,847	13,244	13,076	13,700	14,225	15,430	17,008	5.6%	0.6%
Tennessee	128,716	127,262	139,543	144,125	117,237	101,553	103,953	111,113	115,994	111,572	-13.3%	-1.6%
Texas	464,699	417,633	429,608	411,666	399,704	416,604	441,435	470,840	471,534	469,864	1.1%	0.1%
Utah	30,489	32,351	34,792	40,262	41,916	46,689	51,974	55,866	57,377	62,382	104.6%	8.3%
Virginia	80,567	78,392	85,734	88,590	94,639	103,800	111,939	121,029	127,306	131,848	63.7%	5.6%
Vermont	6,756	6,781	6,953	6,855	7,337	7,726	8,428	8,446	8,931	8,474	25.4%	2.5%
Washington	57,825	57,929	58,158	54,748	56,441	54,766	56,287	59,616	65,766	69,657	20.5%	2.1%
Wisconsin	68,637	69,170	73,941	77,308	77,534	75,405	75,062	76,942	76,563	78,468	14.3%	1.5%
West Virginia	24,427	25,756	27,471	30,349	32,321	32,047	30,452	33,837	33,946	29,370	20.2%	2.1%
Wyoming	5,531	5,944	5,382	5,622	6,562	7,191	7,450	8,034	8,277	8,220	48.6%	4.5%

GM = Geometric Average Change



Appendix Fig. 1. Utilization of interventional pain management techniques (rates) by specialty from 2000 to 2018, in Medicare recipients.