

## Health Policy Review

# Impact Of COVID-19 Pandemic and Updated Utilization Patterns of Sacroiliac Joint Injections from 2000 to 2020 in The Fee-For-Service (FFS) Medicare Population

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**Background:** Among the multiple causes of low back and lower extremity pain, sacroiliac joint pain has shown to be prevalent in 10% to 25% of patients with persistent axial low back pain without disc herniation, discogenic pain, or radiculitis. Over the years, multiple Current Procedural Terminology (CPT) codes have evolved with the inclusion of intraarticular injections, nerve blocks, and radiofrequency neurotomy, in addition to percutaneous sacroiliac joint fusions. Previous assessments of utilization patterns of sacroiliac joint interventions only included sacroiliac joint intraarticular injections, since the data was not available prior to the introduction of new codes. A recent assessment revealed an increase of 11.3%, and an annual increase of 1.2% per 100,000 Medicare population from 2009 to 2018, showing a decline in growth patterns. During the past 2 years, the COVID-19 pandemic has also had significant effects on the utilization patterns of sacroiliac joint interventions.

**Study Design:** The impact of the COVID-19 pandemic and analysis of growth patterns of sacroiliac joint interventions (intraarticular injections, nerve blocks, radiofrequency neurotomy, arthrodesis and fusion) was evaluated from 2010 to 2019 and 2010 to 2020, with a comparative analysis from 2019 to 2020 to assess the impact of the COVID-19 pandemic.

**Objectives:** To update utilization patterns of sacroiliac joint interventions with assessment of the impact of the COVID-19 pandemic.

**Methods:** The Centers for Medicare and Medicaid Services (CMS) Physician/Supplier Procedure Summary (PSPS) Master dataset was utilized in the present analysis.

**Results:** The results of this evaluation demonstrated a significant impact of the COVID-19 pandemic with a 19.2% decrease of utilization of sacroiliac joint intraarticular injections from 2019 to 2020. There was a 23.3% increase in sacroiliac joint arthrodesis and a 5.3% decrease for sacroiliac joint fusions with small numbers from 2019 to 2020. However, data was not available for sacroiliac joint nerve blocks and sacroiliac joint radiofrequency neurotomy as these codes were incorporated in 2020. Overall, from 2010 to 2019, sacroiliac joint intraarticular injections showed an annual increase of 0.9% per 100,000 Medicare population. Sacroiliac joint arthrodesis and fusion showed an annual increase from 2010 to 2020 per 100,000 Medicare population of 29% for arthrodesis and 13.3% for fusion.

**Limitations:** Limitations of this study include a lack of inclusion of Medicare Advantage patients constituting approximately 30% to 40% of the overall Medicare population. As with all claims-based data analyses, this study is retrospective and thus potentially limited by bias. Finally, patients who are non-Medicare are not part of the dataset.

**Conclusions:** The study shows the impact of the COVID-19 pandemic with a significant decrease of intraarticular injections of 19.2% from 2019 to 2020 per 100,000 Medicare population. These

equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

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decreases of intraarticular injections are accompanied by a 5.3% decrease of fusion, but a 23.3% increase of arthrodesis from 2019 to 2020 per 100,000 Medicare population. Overall, the results showed an annual increase of 0.9% per 100,000 Medicare population for intraarticular injections, a 35.4% annual increase for sacroiliac joint arthrodesis and an increase of 15.5% for sacroiliac joint fusion from 2010 to 2019.

**Key words:** Sacroiliac joint nerve blocks, sacroiliac joint radiofrequency neurotomy, sacroiliac joint arthrodesis, sacroiliac joint fusion

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Low back pain is pervasive and responsible for high levels of health care costs and disabilities in the United States and the world (1-5). Published data on health care spending patterns in the United States by Dieleman et al (3-5) assessing the expenses in the United States from 1996 to 2016, showed escalating spending increases in managing low back and neck pain, increasing from \$87.6 billion in 2013 (4) to \$134 billion in 2016 (5), an increase of 53.5%. More recently, the COVID-19 pandemic added major disruptions to the health care system with economic shutdowns, increased pandemic-related hospitalizations, shortage of available medical professionals, and increased requirements for personal protective equipment (PPE) and other expenses, including testing (6-13). Thus, despite reductions in spending patterns for clinical services and disease management, overall health care expenditures in the United States have been increasing, reaching \$4.1 trillion in 2020 (14). This increase in national expenditures has been at a much faster rate than the 4.3% increase seen in 2019 due to the impact of COVID (15). The acceleration in 2020 was due, in part, to a 36% increase in federal expenditures for health care that occurred largely in response to the COVID-19 pandemic. Consequently, the share of the economy devoted to health care spending increased sharply, reaching 19.7% (14). In contrast, in 2019 health care spending increased 4.6% to reach \$3.8 trillion, similar to the rate of growth of 4.7% in 2018, accounting for 17.7% of the gross domestic product in 2019 compared to 17.6% in 2018 (15). Essentially, the COVID-19 impact has reduced expenses in health care due to lockdowns and access issues, but also has caused a multitude of other issues including diminished access to appropriate chronic pain management of various treatment modalities (7-13). COVID-19 has exacerbated the illicit opioid drug epidemic (6).

Based on controlled diagnostic blocks, low back and lower extremity pain has been shown to be

caused by discs, nerve roots, facet joints, and the sacroiliac joint (16-20). The prevalence of sacroiliac joint pain has been described as highly variable from 10% to 25% based on symptomatology and philosophy of the investigators (16). Diagnosis based on controlled diagnostic blocks is only one of multiple approaches. Consequently, multiple modalities of treatments have been advocated in managing sacroiliac joint pain, ranging from simple over the counter medication and home exercises to sacroiliac joint fusion and neuromodulation techniques (21-45). All treatments have been debated on a regular basis for appropriateness of utilization and their effectiveness (6,16-18,21-27,46-65). As a result, the utilization of opioids and interventional techniques, along with multiple other modalities, have significantly decreased over the years (6,11,28). Additionally, COVID-19 had a significant negative effect with an 18.7% decline in interventional techniques (28). In fact, facet joint interventions and sacroiliac joint injections decreased 17.5% from 2019 to 2020. Thus, the global pandemic of COVID-19's major disruption to the overall economy and to healthcare has also affected the utilization of sacroiliac joint interventions (6-10,12,13,64-68).

The utilization patterns of interventional techniques have been described and showed an increase of facet joint interventions and sacroiliac joint injections, even though the growth rate has reduced from 2009 to 2018 at an annual rate of 1.2% increase, compared to an annual increase of 16.6% from 2000 to 2009 (28). However, further analysis showed significant decline or reductions in the growth patterns of epidural injections (47,59), percutaneous adhesiolysis (61), and percutaneous vertebral augmentation procedures (48). The only procedure with growth patterns was spinal cord stimulation implants (49). Further, multiple other modalities have been introduced in recent years with new codes developed for sacroiliac joint nerve blocks and sacroiliac joint radiofrequency which became effective

in 2020 (nerve blocks CPT 64451, radiofrequency CPT 64625), while sacroiliac joint arthrodesis (CPT 27279) introduced in 2016 continues to demonstrate increased interest, as well as fusion of the sacroiliac joint (CPT 27280). While the fusion of the sacroiliac joint has historically been predominantly performed by surgeons, arthrodesis of the sacroiliac joint is being performed by interventional pain management physicians with increasing frequency.

Consequently, in this assessment we have also evaluated the utilization patterns of sacroiliac joint nerve blocks and sacroiliac joint radiofrequency neurotomy for 2020, sacroiliac joint fusion for 2010, and sacroiliac joint arthrodesis from 2016.

## **METHODS**

This retrospective cohort study of the impact of COVID-19 on utilization patterns of sacroiliac joint interventions and overall utilization from 2000 to 2020 was performed with the public use file available through the Centers for Medicare and Medicaid Services (CMS) database (69). The study was performed utilizing criteria established by the Strengthening the Reporting of Observational Studies (STROBE) in epidemiology guidance (70).

## **STUDY DESIGN**

This assessment was designed to evaluate the impact of the COVID-19 pandemic and to update utilization patterns and variables of sacroiliac joint intraarticular injections (CPT 27096), nerve blocks (CPT 64451), neurotomy procedures (CPT 64625), arthrodesis (CPT 27279), and fusion (CPT 27280), from 2010 to 2020 in the Medicare fee-for-service (FFS) population in the United States.

## **OBJECTIVES**

Objectives of this evaluation include not only the impact of the COVID-19 pandemic on utilization patterns, but updated analysis of utilization patterns of sacroiliac joint interventions from 2000 to 2020 in the FFS Medicare population, with the inclusion of usage patterns of newly added codes of facet joint nerve blocks and radiofrequency neurotomy along with fusion procedures.

## **SETTING**

The National Database of Specialty usage data files from CMS in the FFS Medicare population in the United States (69).

## **Participants**

The 100% data from CMS included enrollees in FFS Medicare from 2000 to 2020.

## **Variables**

Multiple variables were assessed including the impact of COVID-19 with comparative data from 2019 to 2020, and usage patterns of sacroiliac joint injections, nerve blocks, neurotomy procedures, fusion procedures, and arthrodesis procedures from 2000 to 2020.

The Current Procedural Terminology (CPT) codes for sacroiliac joint injections utilized were those in effect during 2000 to 2020 as follows: Sacroiliac joint injection (CPT 27096), sacroiliac joint nerve blocks (CPT 64451), and sacroiliac joint radiofrequency neurotomy (CPT 64625) were evaluated. Further, arthrodesis of sacroiliac joint (CPT 27279) and fusion of sacroiliac joint (CPT 27280) were also assessed.

The data were assessed for all procedures in all available settings identifying hospital outpatient department (HOPD), ambulatory surgery center (ASC), and a non-facility setting or office setting.

Data was also assessed with the apportionment of interventional pain procedures performed by each specialty. 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, orthopedic surgery (-20), general surgery (-17), and neurosurgery (-14) are grouped as a surgical group; diagnostic radiology (-30), and interventional radiology (-94) as a radiological group; all other physicians as a separate group; and all other providers were considered as other providers.

## **Data Sources**

The data from CMS Physician/Supplier Procedure Summary (PSPS) Master Data file of FFS Medicare from 2010 to 2020 was obtained and analyzed (69).

## **Measures**

The rate was calculated per 100,000 Medicare beneficiaries. The study of utilization included all allowed services configured by taking services submitted minus services denied and services with zero payments.

## Bias

The data was purchased by the American Society of Interventional Pain Physicians (ASIPP) a not-for-profit organization. In addition, the study was conducted with the internal resources of the practice of the primary authors without external funding. Bias was also avoided based on the fact that data was non-identifiable, non-attributable, and non-confidential.

## Study Size

The study size included an extensive 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 2020.

## Data Compilation

Data were compiled utilizing Microsoft 365 Access and Microsoft 365 Excel (Microsoft, Redmond, WA). The data were calculated for overall services for each procedure, and the rate of services, based on utilization per 100,000 FFS Medicare beneficiaries.

## RESULTS

### Participants

Participants in this assessment included all FFS Medicare recipients from 2000 to 2020.

### Utilization Characteristics

Table 1 and Fig. 1 show the characteristics of Medicare beneficiaries and sacroiliac joint interventions from 2000 to 2020. The rate of utilization for CPT 27096, sacroiliac joint intraarticular injection, per 100,000 Medicare beneficiaries, decreased 19.2% from 2019 to 2020 due to COVID-19. Further, data also confirmed the previously reported data change from 2010 to 2019 with an annual increase of 0.9 and decrease of 1.3% from 2010 to 2020. This is in contrast to an annual increase of 15% from 2000 to 2010. There was no comparative data available for sacroiliac joint nerve blocks, CPT 64451, which were performed 13,288 times and sacroiliac joint radiofrequency neurotomy, CPT 64625, which was performed on 20,022 occasions in contrast to 312,233 procedures of sacroiliac joint intraarticular injections. The data also showed arthrodesis of the sacroiliac joint, CPT 27279. This procedure is also performed by interventional pain physicians and has been available since 2015, whereas fusion of the sacroiliac joint, CPT 27280, has been available since 2008. Ar-

throdesis increased 23.3% from 2019 to 2020 despite COVID-19, whereas fusion decreased 5.3%. Arthrodesis also increased from 2010 to 2019 with an annual increase of 35.4%, whereas fusions increased 15.5%.

Figure 2 shows the utilization patterns of sacroiliac joint intraarticular injections. However, without taking into consideration the COVID-19 pandemic, sacroiliac joint intraarticular injections increased at an annual rate of 0.9% per 100,000 Medicare population from 2010 to 2019.

### Specialty Characteristics

Table 2 shows the utilization of sacroiliac joint intraarticular injections based on provider specialty. Most of the procedures over the years have been performed by interventional pain management specialty (interventional pain management, pain management, anesthesiology, or neurology) constituting 88.5% in 2019 and 89.3% in 2020, with surgeons, radiologists, general physicians, and other physicians as well as certified registered nurse anesthetist (CRNAs), nurse practitioners, and physician assistants (PAs) constituting the remaining 11.5% and 10.7%.

Table 3 shows the specialty utilization of arthrodesis, CPT 27279, with 34.4% of the procedures performed by interventional pain management specialties, whereas 64.8% were performed by neurosurgeons and orthopedic surgeons combined, with 0.8% performed by all other providers, in 2020, with increasing frequency and proportion by interventional pain physicians.

Table 4 shows the utilization patterns of fusion, predominantly performed by surgeons, with 97%, followed by all other specialists, only 3% in 2020.

### Site of Service Characteristics

Figure 3 shows the frequency of utilization of sacroiliac joint interventions in various sites available.

## DISCUSSION

This expanded and updated assessment of utilization data of sacroiliac joint interventions in the Medicare FFS population from 2000 to 2020 shows an overall reversal of growth of intraarticular sacroiliac joint injections. There was an increase in arthrodesis rates though utilization was low and there were a small number of procedures performed with sacroiliac joint nerve blocks and sacroiliac joint radiofrequency neurotomy. This study showed significant reductions of sacroiliac joint injections from 2019 to 2020 with a decline of 19.2%. However, this evaluation also

COVID-19 Pandemic and Updated Utilization Patterns of Sacroiliac Joint Injections

Table 1. Characteristics of Medicare beneficiaries and sacroiliac joint interventions from 2000 to 2020.

Year	Number of Individuals Participating in Medicare	Sacroiliac Joint Intraarticular Injections				Arthrodesis Sacroiliac Joint		Fusion Of Sacroiliac Joint	
		Services	% of Change	Rate per 100,000 Medicare Beneficiaries	% of Change from Previous Year	Services	Rate per 100,000 Medicare Beneficiaries	Services	Rate per 100,000 Medicare Beneficiaries
Y2000	39,632	49,554 (59%)		125					
Y2010	46,914	85,664 (42%)	3.9%	507	1.4%			318	0.7
Y2011	48,300	101,749 (43%)	6.2%	523	3.2%			648	1.3
Y2012	50,300	128,864 (45%)	5.6%	530	1.4%			1,399	2.8
Y2013	51,900	172,704 (47%)	0.0%	514	-3.1%			1,864	3.6
Y2014	53,500	188,606 (47%)	4.6%	521	1.5%			1,806	3.4
Y2015	54,900	211,928 (48%)	6.5%	541	3.8%	1,280#	2.3	1,140#	2.1
Y2016	56,500	213,489 (50%)	6.2%	558	3.2%	1,808	3.2	1,126	2.0
Y2017	58,000	228,687 (50%)	3.2%	561	0.6%	2,233	3.9	1,222	2.1
Y2018	59,600	228,946 (50%)	1.8%	556	-0.9%	2,824	4.7	1,396	2.3
Y2019	61,200	337,613 (50%)	1.8%	552	-0.8%	3,572	5.8	1,523	2.5
Y2020	62,600	278,923 (49%)	-17.4%	446	-19.2%	4,504	7.2	1,475	2.4
Change from									
2000-2020	58.0%	462.9%		256.4%					
GM	2.3%	9.0%		6.6%					
2000-2010	18.4%	380.1%		305.6%					
GM	1.7%	17.0%		15.0%					
2010-2019	30.5%	41.9%		8.8%		179.1%*	150.3%*	378.9%	267.1%
GM	3.0%	4.0%		0.9%		40.3%*	35.4%*	19.0%	15.5%
2010-2020	33.4%	17.2%		-12.1%		252%	252%	363.8%	247.6%
GM	2.9%	1.6%		-1.3%		29%	29%	16.6%	13.3%
2019-2020		-17.4%		-19.2%		26.1%	23.3%	-3.2%	-5.3%

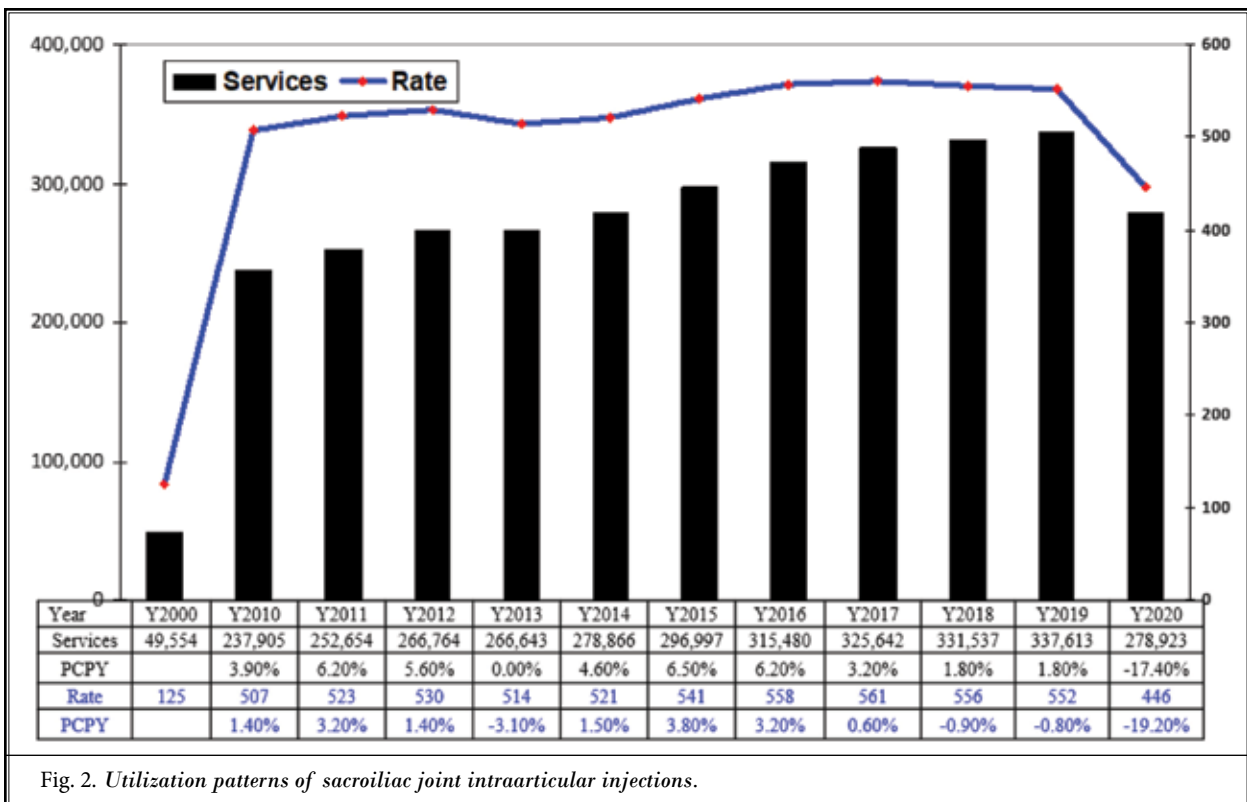
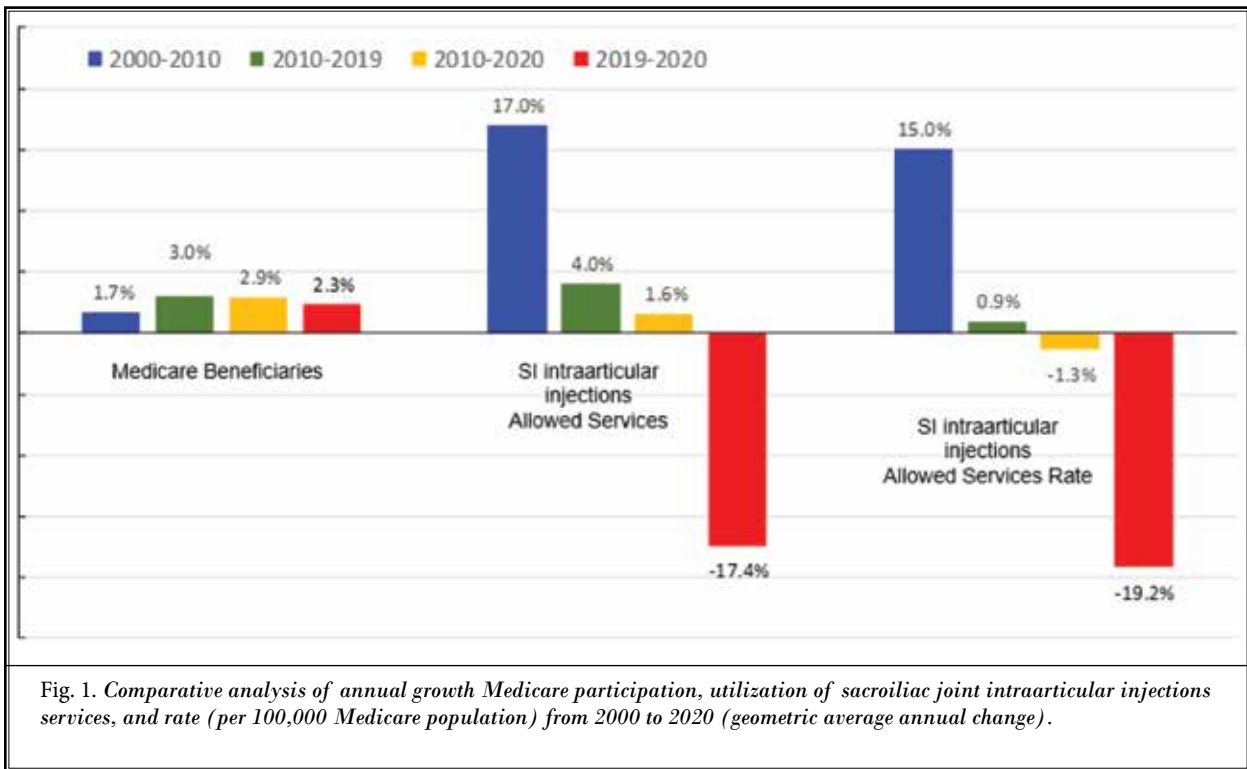
CPT 27279 started in 2015 and CPT code 27280 started in 2008. # based on 5% data.

\* from 2015 to 2019 GM - Geometric average annual change ( ) facility percentage

showed an increase of arthrodesis of the sacroiliac joint of 23.3%, whereas the fusion of the sacroiliac joint decreased by 5.3%. The remaining data from 2000 to 2020 was similar to our previous publications with intraarticular injections from 2010 to 2019 showing an annual increase of 0.9%, whereas arthrodesis of the

2020 data for sacroiliac joint nerve blocks and sacroiliac joint radiofrequency thermoneurolysis

HCPCS_CD	Allowed Services
64451 - Sacroiliac joint nerve blocks	13288
64625 - Sacroiliac joint radiofrequency thermoneurolysis	20022





COVID-19 Pandemic and Updated Utilization Patterns of Sacroiliac Joint Injections

Table 2. Utilizations of sacroiliac joint intraarticular injections by specialty in the Medicare population from 2000-2020

Year	Interventional Pain Management		Surgery		Radiology		General Physicians		Other Physicians		CRNA, NP & PA	
	Services (Percent)	Rate	Services (Percent)	Rate	Services (Percent)	Rate	Services (Percent)	Rate	Services (Percent)	Rate	Services (Percent)	Rate
F2000	40,274 (81.3%)	102	2,778 (5.6%)	7	2,171 (4.4%)	5	1,260 (2.5%)	3	3,050 (6.2%)	8	21 (0.04%)	0.05
F200	202,386 (85.1%)	431	9,473 (4.0%)	20	6,570 (2.8%)	14	11,360 (4.8%)	24	4,584 (1.9%)	10	3,532 (1.5%)	7.53
F2011	215,207 (85.2%)	446	9,005 (3.6%)	19	7,288 (2.9%)	15	11,079 (4.4%)	23	5,122 (2.0%)	11	4,953 (2.0%)	10.25
F2012	228,968 (85.8%)	455	8,994 (3.4%)	18	8,253 (3.1%)	16	10,625 (4.0%)	21	3,563 (1.3%)	7	6,361 (2.4%)	12.65
F2013	229,739 (86.2%)	443	9,361 (3.5%)	18	8,019 (3.0%)	15	10,278 (3.9%)	20	3,380 (1.3%)	7	5,866 (2.2%)	11.3
F2014	242,896 (87.1%)	454	10,619 (3.8%)	20	8,430 (3.0%)	16	8,726 (3.1%)	16	3,361 (1.2%)	6	4,834 (1.7%)	9.04
F2015	259,079 (87.2%)	472	11,233 (3.8%)	20	9,171 (3.1%)	17	8,160 (2.7%)	15	3,477 (1.2%)	6	5,877 (2.0%)	10.7
F2016	275,364 (87.3%)	487	11,118 (3.5%)	20	10,430 (3.3%)	18	8,757 (2.8%)	15	3,402 (1.1%)	6	6,409 (2.0%)	11.34
F2017	284,540 (87.4%)	491	10,616 (3.3%)	18	10,734 (3.3%)	19	10,122 (3.1%)	17	2,788 (0.9%)	5	6,842 (2.1%)	11.8
F2018	292,950 (88.4%)	492	11,551 (3.5%)	19	11,144 (3.4%)	19	7,157 (2.2%)	12	2,496 (0.8%)	4	6,239 (1.9%)	10.47
F2019	298,896 (88.5%)	488	11,752 (3.5%)	19	11,868 (3.5%)	19	5,960 (1.8%)	10	2,769 (0.8%)	5	6,368 (1.9%)	10.41
F2020	278,726 (89.3%)	445	10,582 (3.4%)	17	9,631 (3.1%)	15	4,669 (1.5%)	7	2,362 (0.8%)	4	6,263 (2.0%)	10
Change 2000-2020	592.1%	338.2%	280.9%	141.2%	343.6%	180.9%	270.6%	134.6%	-22.6%	-51.0%	29723%	18781%
GM	10.2%	7.7%	6.9%	4.5%	7.7%	5.3%	6.8%	4.4%	-1.3%	-3.5%	33.0%	30.0%
Change 2000-2010	402.5%	324.5%	241.0%	188.1%	202.6%	155.7%	801.6%	661.6%	50.3%	27.0%	16719%	14108%
GM	17.5%	15.6%	13.1%	11.2%	11.7%	9.8%	24.6%	22.5%	4.2%	2.4%	66.9%	64.2%
change 2010-2020	37.7%	3.2%	11.7%	-16.3%	46.6%	9.9%	-58.9%	-69.2%	-48.5%	-61.4%	77.3%	32.9%
GM	3.3%	0.3%	1.1%	-1.8%	3.9%	0.9%	-8.5%	-11.1%	-6.4%	-9.1%	5.9%	2.9%
Change 2019-2020	-6.7%	-8.8%	-10.0%	-12.0%	-18.8%	-20.7%	-21.7%	-23.4%	-14.7%	-16.6%	-1.6%	-3.8%

CRNA=certified registered nurse anesthetist; NP=nurse practitioner; PA=physician assistant; GM=geometric average

sacroiliac joint showing an annual increase of 35.4% and fusion of the sacroiliac joint showing an annual increase of 15.5% per 100,000 Medicare beneficiaries.

All of the data is strikingly different with the reversal of growth patterns compared to 2000 to 2010, which showed an annual increase of 15% of intraarticular

injections. These increases have been shown to be similar to lumbar facet joint interventions during these periods. However, they contrasted with the decreases of lumbar interlaminar epidural procedures (47,59), percutaneous adhesiolysis procedures (61), and ver-

tebral augmentation procedures (48), which showed significant declines, but significantly lower than spinal cord stimulation procedures (49). The present data is similar to our previous publications.

While the criticism continues because of the lack of convincing literature to support sacroiliac joint interventions, there is moderate literature demonstrating the diagnostic value of sacroiliac joint injections (16,32-34). The evidence of the therapeutic utility of sacroiliac joint interventions, including intraarticular injections (16,32), sacroiliac joint nerve blocks, sacroiliac joint radiofrequency neurotomy (16,34,35,38,40,42), fusion (43,44), and arthrodesis procedures is evolving and mixed (45). Is limited? In the past, the data was hampered due to the lack of coding patterns for nerve blocks and radiofrequency neurotomy. Further, we also have not assessed the role of fusion and arthrodesis. Arthrodesis is performed on one-third of the occasions by interventional pain physicians. While the available data is modest for sacroiliac joint intraarticular injections and radiofrequency neurotomy, it is limited for arthrodesis, which seems to be increasing at a rapid pace with a 252% increase from 2016 to 2020 for an annual increase of 29%. Further, introduction of arthrodesis also has stabilized usage patterns of fusion procedures with an annual increase of 13.3% per 100,000 Medicare beneficiaries.

Table 3. Utilization patterns of arthrodesis of sacroiliac joint (CPT 27279) by specialty.

Specialty	2016	2017	2018	2019	2020
Anesthesiology - 05	4	14	18	136	398
IPM - 09		7	43	241	605
Pain Management - 72		5	25	151	375
PM&R - 25		9	9	80	165
Neurology - 13	1	7	5	3	5
Interventional Pain Management	5	42	100	611	1548
Percent	0.3%	1.9%	3.5%	17.1%	34.4%
Neurosurgery - 14	808	949	1119	1193	1186
Orthopedic Surgery - 20	961	1214	1594	1740	1732
Surgeons	1769	2163	2713	2933	2918
Percent	97.8%	96.9%	96.1%	82.1%	64.8%
Other Providers	34	28	11	28	38
percent	1.9%	1.3%	0.4%	0.8%	0.8%
Total	1808	2233	2824	3572	4504

Table 4. Utilization patterns of fusion of sacroiliac joint (CPT 27280) by specialty.

Specialty	2010	2011	2012	2013	2014	2016	2017	2018	2019	2020
Neurosurgery - 14	65	199	509	825	692	434	498	650	746	681
Orthopedic Surgery - 20	234	429	874	1021	1104	680	708	707	747	756
General Surgery- 02	1		1	1		1				
Surgeons	300	628	1384	1847	1796	1115	1206	1357	1493	1437
Percent	94%	97%	99%	99%	99%	99%	99%	97%	98%	97%
IPM - 09					1			18	6	10
Pain Management - 72						1	1			2
PM&R - 25	6			2				3	1	1
Neurology - 13	3	15	6	2	1	2	1	9	6	8
Diagnostic Radiology - 30	3	2	2		1				1	5
General Practice - 01				1	1					
Internal Medicine - 11	3									
Osteopathic - 12				1		1	2	4	5	6
Emergency Medicine - 93		1	2			1	2			
Others Physicians	3			6	6	6	9	2	3	4
Other Providers	18	20	15	17	10	11	16	39	30	38
Percent	6%	3%	1%	1%	1%	1%	1%	3%	2%	3%
Total	318	648	1399	1864	1806	1126	1222	1396	1523	1475



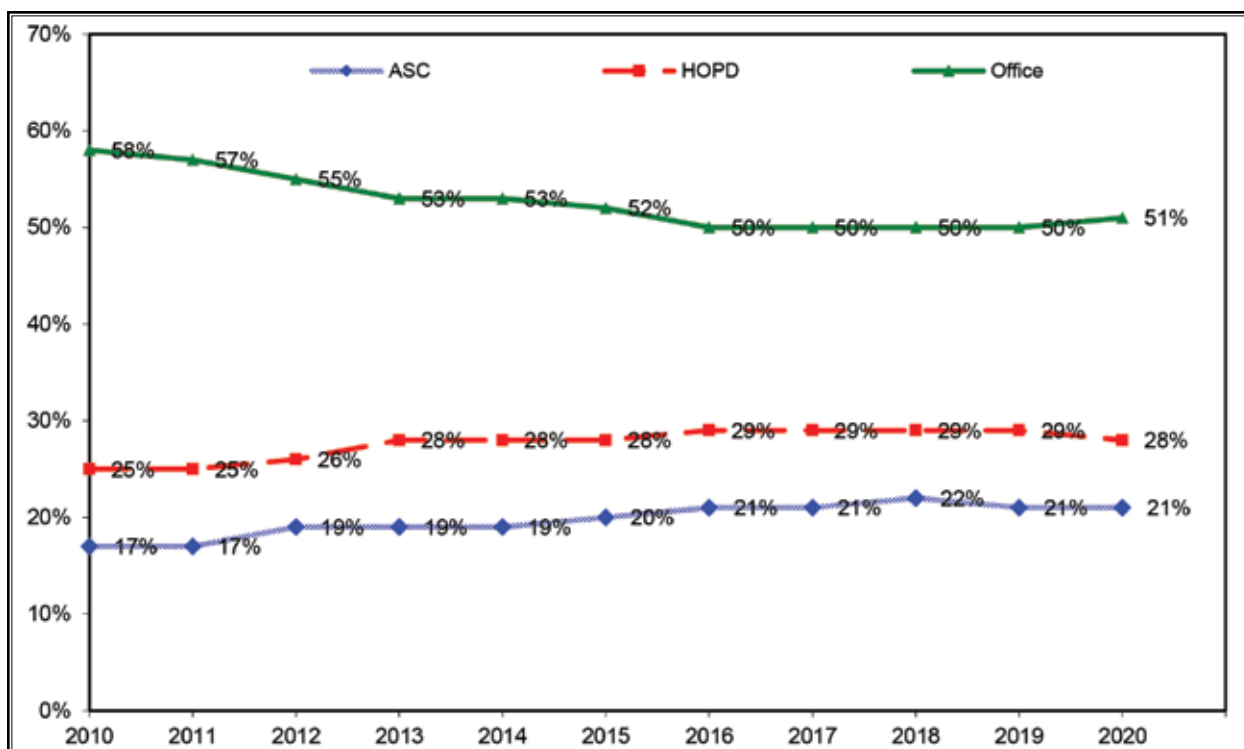


Fig. 3. Frequency of utilization of sacroiliac joint interventions in various settings.

The COVID-19 pandemic, in conjunction with the opioid epidemic, has resulted in multiple issues affecting access to chronic pain patients. The literature has shown significant reductions in opioid prescriptions with a decrease in the number of prescriptions and average doses administered. Interventional techniques, despite escalating opioid deaths, are down as well. Further, devastating effects of the COVID-19 pandemic have caused major disruptions to the overall economy and to healthcare with economic shutdowns, increased pandemic-related hospitalizations, shortages of available medical professionals and PPE (6-10,12,13,64-68). In addition to this, increased disease surveillance and testing in addition to increasing staff requirements and expenses, has contributed to major changes in the way healthcare is being delivered. This new burdensome healthcare restructuring continues to pose challenges due to a decrease in chronic pain care access thereby predisposing patients to opioid dependence and overdose-related deaths (6). While healthcare expenditures increased due to COVID-19, private health insurance spending decreased by 1.2% because of the decline in enrollment and lower utilization, accounting for 28% of total health care expenditures, or \$1.15 trillion in

2020 (14,15). It is also interesting to note that total private health insurance spending for medical goods and services decreased 3.5% in 2020 to \$1 trillion secondary to the pandemic-related reductions in health care use, particularly for some elective procedures, along with economic shutdowns and moratorium on certain procedures, resulting in a 5.9% decrease in hospital care, 2.6% in physician and clinical services, and 3.8% for dental services. Medicare spending also showed a deceleration to 3.5% growth rate in 2020 was compared to 6.9% in 2019 (14,15). Additionally, expansion in Medicaid also contributed to issues related to access with increasing copays and deductibles for commercial payers and Medicare Advantage plans. Overall, since the previous publications, there have been multiple changes due to the COVID-19 pandemic with an onset of a fourth wave of the illicit drug epidemic (17,18,21,55-57,62,63,71,72).

The limitations of this assessment include the lack of inclusion of Medicare Advantage plans, which have shown to constitute almost 40% of the Medicare population in 2020 where on average, it was 30% for prior years, and Medicaid, other government plans, and commercially insured plans. Even then, the pres-

ent assessment is very similar to Medicare Advantage plans and other carriers with enhanced implementation of reduction strategies. As with all claims-based data reviews, this retrospective analysis could be influenced by reviewer bias; however, we have taken all appropriate precautions to avoid any such bias. Further advantages include conflicts related to funding and inclusion of newer codes, which have not been studied in the past.

## CONCLUSION

This present updated and expanded assessment of the COVID-19 impact on interventional techniques showed a significant decrease of 19.2% of sacroiliac joint intraarticular injections, with an increase of 23.3% for arthrodesis of sacroiliac joint and a decrease of 5.3% for fusion of sacroiliac joint per 100,000 Medicare population from 2019 to 2020. There were no data available for comparison purposes of sacroiliac joint nerve blocks and sacroiliac joint radiofrequency neurotomy as the codes were introduced in 2020. Overall, sacroiliac joint intraarticular injections have been on a declining path compared to 2010 with 0.9% annual increase from 2010 to 2019 and 1.3% decrease from 2010 to 2020, compared to 15% annual increase from 2000 to 2010. The proportion of arthrodesis procedures performed by interventional pain physicians was about one-third, whereas fusion procedures were largely performed by surgeons.

## Author Contributions

The study was designed by LM, VS, and JAH.  
Statistical analysis was performed by VS.

All authors contributed to preparation to the manuscript, reviewed, and approved the content with final version.

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## Conflict of Interest

Dr. Simopoulos is a consultant for Nevro, Boston Scientific and Spectra Medical.

Dr. Soin is the founder and CEO of Soin Neuroscience, which is developing a spinal cord stimulator to treat spinal pain and has a patent for Soin Neuroscience, Jan One, and Avanos and a patent pending for Soin Therapeutics.

Dr. Abd-Elsayed is a consultant of Medtronic, Avanos, and Averitas.

Dr. Hirsch is a consultant for Medtronic and Senior Affiliate Research Fellow at the Neiman Policy Institute.

Dr. Beall is a consultant for Medtronic, Merit Medical, IZI, Techlamed, Boston Scientific, Stryker, Lenoss Medical, Spine BioPharma, Piramal, ReGelTec, Spinal Simplicity, Smart Soft, Tissue Tech, Vivex, Stratus Medical, Genesys, Abbott, Eliquence, SetBone Medical, Amber Implants, and Cerapedics.

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