Health Care Utilization and Costs in the Year Prior to Arthroscopic Rotator Cuff Repair

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Background: A majority of cost-control strategies in arthroscopic rotator cuff repair (RCR) have been concentrated on the perioperative and post–acute care periods, with the preoperative health care period being largely overlooked.

Purpose: To report the distribution of costs associated with health care utilization within the year prior to arthroscopic RCR.

Study Design: Economic and decision analysis; Level of evidence, 3.

Methods: The 2007 through 2015 (third quarter) Humana Administrative Claims database was queried using Current Procedural Terminology code 29827 to identify patients undergoing arthroscopic RCR for only degenerative rotator cuff tears. The study cohort was divided into 2 distinct groups based on insurance plan: commercial or Medicare Advantage (MA). Total 1-year costs, per-patient average reimbursements (PPARs), and trends in utilization for the following preoperative health care resource categories were studied: office visits, radiographs, magnetic resonance imaging (MRI) scans, computed tomography (CT) scans, steroid injections, hyaluronic acid (HA) injections, physical therapy, and pain medications (opioids + nonopioids).

Results: A total of 18,457 MA and 6530 commercial beneficiaries undergoing arthroscopic RCR over the study period were included. Total 1-year preoperative costs (in US$) amounted to $16,923,595 ($916/patient) and $8,397,291 ($1285/patient) for MA and commercial beneficiaries, respectively. The largest proportion of total 1-year costs for both MA and commercial beneficiaries was accounted for by MRI scans (36% and 56%, respectively). PPARs for each health care resource category were as follows: office visits (MA, $240; commercial, $249), radiographs (MA, $60; commercial, $93), MRI scans (MA, $385; commercial, $813), CT scans (MA, $223; commercial, $562), steroid injections (MA, $97; commercial, $137), HA injections (MA, $422; commercial, $602), physical therapy (MA, $473; commercial, $551), and pain medications (MA, $208; commercial, $136). High health care utilization within the past 3 months before surgery was noted for radiographs, physical therapy, opioids, steroid injections, and office visits, with up to 40% to 90% of 1-year PPARs being accounted for within this time period alone.

Conclusion: Approximately $900 to $1300 per patient was spent in rotator cuff–related health care resource use in the year prior to undergoing arthroscopic RCR. As we begin to implement value in shoulder surgery, judicious use of nonoperative treatment modalities among patients who would not benefit from nonoperative care will be an effective way of reducing costs.

Keywords: rotator cuff; resource utilization; health care expenses; insurance

Accounting for more than 4.5 million patient visits annually in the United States, shoulder pain secondary to rotator cuff tears constitutes a significant cost burden on the health care system.[16,25,31] With the prevalence of rotator cuff tears rising with age, compounded by an aging national population, it is anticipated that the health care burden associated with care for rotator cuff tears will increase even further. Although the choice of treatment (operative vs nonoperative) for symptomatic rotator cuff tears remains controversial (driven by either patient/physician preference in lack of high-quality evidence[23]), there has been a rapid increase in the utilization of arthroscopic rotator cuff repair (RCR) over time.[1,8,15]

As the current health care system transitions from a fee-for-service model to a value-based payment system, it is imperative to examine methods of maximizing quality of care while minimizing costs associated with highly utilized surgical procedures.[13] The majority of cost-control/cost-minimization research in arthroscopic RCR has been focused on the perioperative and post–acute care periods, with the preoperative health care period being largely overlooked.[7,9,20-22,27] Given that surgical RCR typically

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represents a population that has failed nonoperative treatment, understanding preoperative health care utilization, with regard to nonoperative modalities and diagnostic tests, will help providers to make the best decisions for their patients in a value-based care environment. In light of the latter observations, we sought to utilize a national insurance claims data set to understand the costs associated with health care utilization in the year before elective arthroscopic RCR. We hypothesized that patients incur a significant amount of costs within the 1 year prior to undergoing elective arthroscopic RCR.

METHODS

Database

This was a retrospective study performed using the Humana Administrative Claims (HAC) data set, accessed through the PearlDiver database. The PearlDiver database is a subscription-based and HIPAA–compliant research repository that contains data sets from multiple payers including Medicare and the private insurer Humana. The data sets can be queried using combinations of International Classification of Diseases (ICD) 9th/10th Revision diagnosis and procedure codes as well as Current Procedural Terminology (CPT) codes. The data sets are accessed through third-party software that is hosted on a remote desktop connection. Further details regarding the PearlDiver database can be found on its official website (www.pearldiverinc.com). As all of the data stored on the PearlDiver database are deidentified, the study was exempt from institutional review board approval.

Patient Selection

The 2007 to 2015 (third quarter) HAC database was queried using CPT code 29827 and ICD-9 codes to identify patients undergoing arthroscopic RCR for only degenerative rotator cuff tears. Patients undergoing concomitant arthroplasty (total shoulder arthroplasty and/or hemiarthroplasty), repair for traumatic rotator cuff tears, open RCR, and/or fracture fixation were excluded. Only those patients who were actively enrolled in the insurance plan up to 1 year prior to surgery were included. The study cohort was divided into 2 distinct groups based on insurance plan for descriptive and analytical purposes: commercial or Medicare Advantage (MA). The cohort was divided primarily because both groups have distinct resource utilization demands, largely owing to different baseline comorbidity burdens, as well as minimum age requirements for enrollment eligibility. Reimbursement policies are also different for MA and/or commercial insurance beneficiaries, with the latter plan reimbursing a much higher proportion of the initial demanded charges to providers.

Health Care Utilization Categories

Preoperative health care utilization was defined according to the following categories: office visits, radiographs, magnetic resonance imaging (MRI) scans, computed tomography (CT) scans, steroid injections, hyaluronic acid (HA) injections, physical therapy, and pain medications (opioids + nonopioids). A complete list of codes used to retrieve bills associated with the health care resource categories can be found in the Appendix. All health care categories, with the exception of pain medications, were cross-referenced with diagnoses of rotator cuff tear and/or shoulder pain to ensure that only relevant billing records were retrieved. Total 1-year costs for the entire study period were calculated. Per-patient average reimbursements (PPARs) for each health care resource category have also been reported. The terms "costs" and "reimbursements" refer to actual payments made by the insurance company to the service provider and are used interchangeably throughout the article. Trends in health care utilization for physical therapy, opioids, steroid injections, MRI scans, radiographs, and office visits over the 1-year preoperative period have also been reported.

RESULTS

Patient Population

After the application of inclusion/exclusion criteria, 24,987 patients were included, of whom 18,457 (73.9%) were MA beneficiaries and 6530 (26.1%) were commercial beneficiaries. A complete description of baseline clinical characteristics of the study groups can be seen in Table 1.

Costs and Trends Associated With Preoperative Health Care Utilization

Total 1-year preoperative costs (in US$) amounted to $8,397,291 ($1285/patient) and $16,923,595 ($916/patient) for commercial and MA beneficiaries, respectively. The largest proportion of total 1-year costs for both groups was accounted for by MRI scans (56% in commercial; 36% in MA), followed by office visits (17% in commercial; 25% in

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Ethical approval was not sought for the present study.

TABLE 1
Baseline Characteristics of Study Population[a]

	MA (n = 18,457)	Commercial (n = 6530)
Age, y		
<40	28 (0.2)	392 (6.0)
40-54	1054 (5.7)	2704 (41.4)
55-69	8346 (45.2)	3289 (50.4)
70-79	8024 (43.5)	131 (2.0)
≥80	1005 (5.4)	14 (0.2)
Sex		
Female	9305 (50.4)	2523 (38.6)
Male	9152 (49.6)	4007 (61.4)
Region		
Midwest	4062 (22.0)	1849 (28.3)
Northeast	427 (2.3)	17 (0.3)
South	11,808 (64.0)	4156 (63.6)
West	2160 (11.7)	508 (7.8)
Elixhauser Comorbidity Index, mean ± SD	7.7 ± 4.4	3.5 ± 3.2

[a]Data are shown as n (%) unless otherwise indicated. MA, Medicare Advantage.

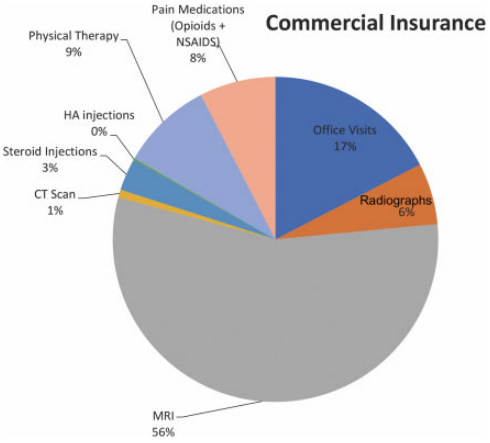

Figure 1. Distribution of 1-year costs in commercial beneficiaries. CT, computed tomography; HA, hyaluronic acid; MRI, magnetic resonance imaging; NSAIDs, nonsteroidal anti-inflammatory drugs.

MA) (Figures 1 and 2). Pain medications (which included opioids and nonopioids/nonsteroidal anti-inflammatory drugs [NSAIDs]) were prescribed in 71% to 77% of all patients, accounting for 8% and 17% of the total 1-year costs for commercial and MA beneficiaries, respectively. Only 21% of patients underwent physical therapy before surgery, accounting for 9% and 11% of the total 1-year costs for commercial and MA beneficiaries, respectively. Around 30% to 38% of patients received at least 1 steroid injection within the year prior to arthroscopic RCR, with total 1-year costs for commercial and MA beneficiaries being $17,735 (4.8% of total cost) and $198,796 (7.1% of total cost),

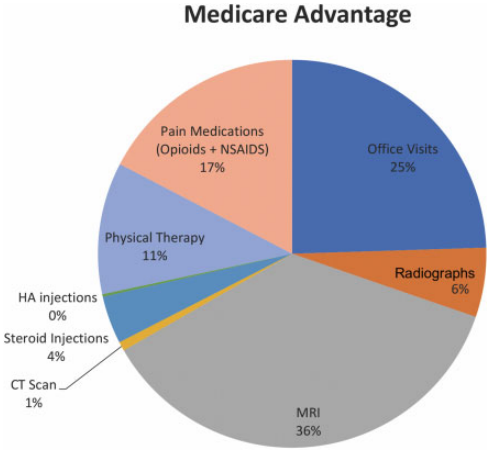

Figure 2. Distribution of 1-year costs in Medicare Advantage beneficiaries. CT, computed tomography; HA, hyaluronic acid; MRI, magnetic resonance imaging; NSAIDs, nonsteroidal anti-inflammatory drugs.

respectively. Only a small proportion of patients (<1%) received an HA injection. A complete proportional distribution, in percentages, for total 1-year costs is shown in Figures 1 (commercial) and 2 (MA).

PPARs for each health care resource category were as follows: office visits (commercial, $249; MA, $240), radiographs (commercial, $93; MA, $60), MRI scans (commercial, $813; MA, $385), CT scans (commercial, $562; MA, $223), steroid injections (commercial, $137; MA, $97), HA injections (commercial, $602; MA, $422), physical therapy (commercial, $551; MA, $473), and pain medications (commercial, $136; MA, $208) (Table 2).

High health care utilization within the 3 months prior to surgery was noted for radiographs, physical therapy, opioids, steroid injections, and office visits, with up to 40% to 90% of 1-year PPARs being accounted for within this time period alone (Figure 3). Of note, nearly 78% to 80% of the 1-year PPARs for steroid injections and 41% to 47% of the 1-year PPARs for opioids were accounted for within the 3 months before surgery.

DISCUSSION

This study characterized the distribution of costs and resource utilization in the year before undergoing RCR for degenerative rotator cuff tears by analyzing commercial and MA insurance claims from a national database. Our findings demonstrate that, on average, $900 to $1300 was spent on shoulder-related health care in the year before undergoing arthroscopic RCR. Furthermore, it appears that the utilization rates for certain nonoperative treatment modalities, such as opioids and steroid injections, were the highest within the past 3 months directly before surgery.

Based on our study's findings, only 21% of patients received some form of physical therapy in the year prior to arthroscopic RCR. Although the low utilization rate of

TABLE 2
Distribution of PPARs for Each Health Care Resource Category Over a 1-Year Period Prior To Surgery[a]

	Patients, n (%)	0-3 mo	0-6 mo	0-1 y
Office visits				
Commercial	5868 (89.9)	$186 (74.7)	$220 (88.4)	$249 (100.0)
MA	17,281 (93.6)	$172 (71.7)	$208 (86.7)	$240 (100.0)
Radiographs				
Commercial	5521 (84.5)	$83 (89.2)	$88 (94.6)	$93 (100.0)
MA	16,245 (88.0)	$53 (88.3)	$56 (93.3)	$60 (100.0)
MRI scans				
Commercial	5753 (88.1)	$777 (95.6)	$794 (97.7)	$813 (100.0)
MA	16,020 (86.8)	$371 (96.4)	$376 (97.7)	$385 (100.0)
CT scans				
Commercial	115 (1.8)	$610 (-)	$577 (-)	$562 (100.0)
MA	577 (3.1)	$222 (-)	$220 (-)	$223 (100.0)
Steroid injections				
Commercial	1964 (30.1)	$110 (80.3)	$122 (89.1)	$137 (100.0)
MA	6933 (37.6)	$76 (78.4)	$84 (86.6)	$97 (100.0)
HA injections				
Commercial	22 (0.3)	$683 (-)	$661 (-)	$602 (100.0)
MA	85 (0.5)	$371 (-)	$425 (-)	$422 (100.0)
Physical therapy				
Commercial	1391 (21.3)	$387 (70.2)	$479 (86.9)	$551 (100.0)
MA	3934 (21.3)	$337 (71.2)	$415 (87.7)	$473 (100.0)
Pain medications (opioids + NSAIDs)				
Commercial	4664 (71.4)	$59 (43.3)	$88 (64.7)	$136 (100.0)
MA	14,149 (76.7)	$76 (36.5)	$124 (59.6)	$208 (100.0)
Opioids				
Commercial	3584 (54.9)	$28 (47.4)	$50 (84.7)	$59 (100.0)
MA	11,344 (61.5)	$36 (40.9)	$56 (63.6)	$88 (100.0)

[a]Data are shown as PPAR in US$ (% of total cost) unless otherwise indicated. Hyphen indicates no percentage calculation as sample size of patients was less than 12. CT, computed tomography; HA, hyaluronic acid; MA, Medicare Advantage; MRI, magnetic resonance imaging; NSAIDs, nonsteroidal anti-inflammatory drugs; PPAR, per-patient average reimbursement.

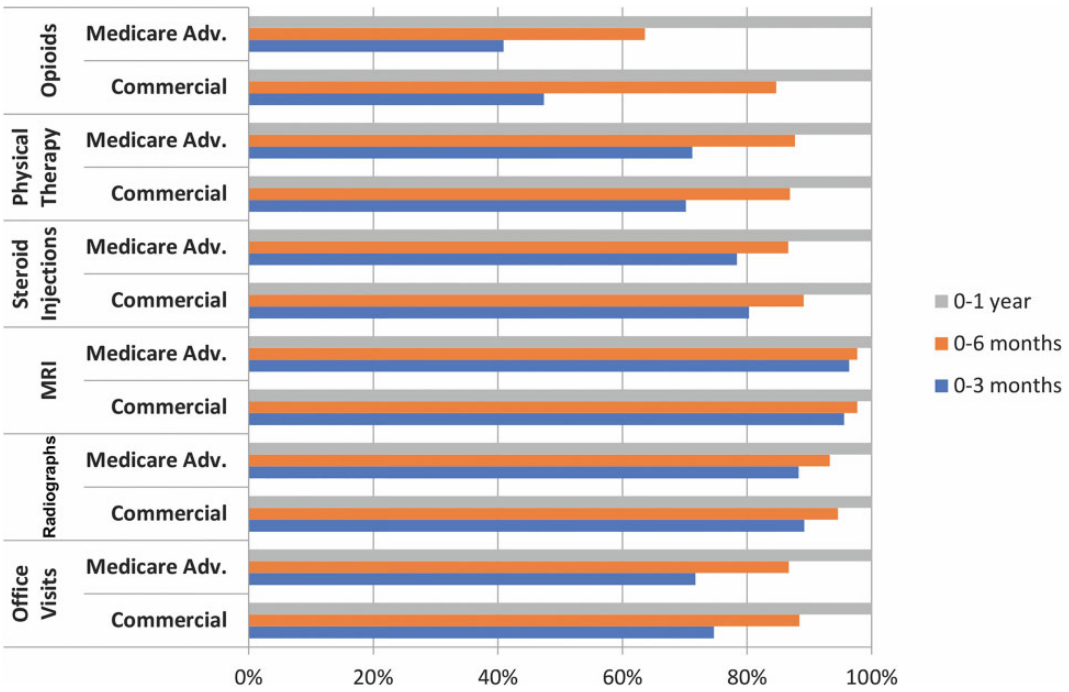

Figure 3. Trends in health care utilization per category over the 1-year period prior to surgery. MRI, magnetic resonance imaging.

physical therapy is consistent with recent trends,[1] the observation is surprising, given that recent evidence has shown physical therapy to be a cost-effective modality for the management of atraumatic rotator cuff tears.[3,12,32] According to a Multicenter Orthopaedic Outcomes Network shoulder study, the implementation of a strict physical therapy protocol, comprising home- and office-based therapy, was effective for treating atraumatic full-thickness rotator cuff tears in nearly 75% of the population.[18] In another study comparing physical therapy to surgery as a mainstay treatment of atraumatic rotator cuff tears, Kukkonen et al[19] noted that clinical outcomes did not differ between the 2 groups at 2-year follow-up points. The underutilization of physical therapy in our study could likely be stemming from limited evidence facilitating a discussion on what type of patients would benefit from this nonoperative modality. It is also possible that patients who benefited from physical therapy might have avoided the need for arthroscopic repair and were therefore not captured by our inclusion criteria. Recent evidence has also shown that the decision to opt for surgical repair is influenced the most by low patient expectations regarding the effectiveness of physical therapy,[11] further driving a discussion on the need for better patient education to facilitate well-informed decision making.

As expected, a majority of the preoperative costs were attributable to imaging (particularly MRI scans) and office visits. Nearly 96% of the 1-year PPARs for MRI scans were accounted for within the 3 months before surgery, likely indicating the use of this imaging modality in preoperative planning. While MRI is the preferred gold standard imaging modality for assessing shoulder abnormalities, ultrasound may be a more cost-effective modality with a similar efficacy in determining the prevalence and size of rotator cuff tears. According to recent reports, ultrasound visualizes the integrity of anatomic structures in patients with symptomatic and asymptomatic rotator cuff tears with a similar sensitivity and specificity to MRI.[6,10] In addition, ultrasound is relatively cheaper compared with MRI, with reports showing a minimal difference in quality-adjusted life years between the 2 imaging modalities.[14] However, it is important to note that using ultrasound for identifying rotator cuff tears is associated with a significant learning curve (ie, use of ultrasound is highly user dependent). Moreover, proponents of MRI debate that the imaging modality offers superior visualization of intra-articular abnormalities and greater familiarity to most shoulder surgeons. Incorporating ultrasound training early in resident education could be an effective way of ensuring that incoming orthopaedic surgeons and/or musculoskeletal radiologists are well-adapted to using the imaging modality in their practice.

While the direct costs associated with preoperative opioid prescriptions within the previous 3 months in our study cohort were not large ($28-$36/patient), providers need to understand the indirect costs associated with the negative impact of preoperative opioid usage on postoperative clinical outcomes. Williams et al[30] retrospectively analyzed a cohort of 200 patients who underwent surgical RCR for full-thickness or partial-thickness tears and observed inferior postoperative outcome scores in the 44 patients who received preoperative opioid prescriptions. Preoperative opioid use is associated with a higher likelihood of prolonged opioid usage and increased dose requirements after arthroscopic RCR.[5,24,30] Similarly, Sabesan et al[24] examined a cohort of 79 patients who underwent arthroscopic RCR and observed that the patients with no opioid use had significantly higher patient-reported postoperative outcomes than the patients with a history of preoperative opioid use. Patients with preoperative opioid use did not reach the same level of functionality postoperatively as patients who did not use opioids and reported higher postoperative pain scores.[24,30] In a retrospective examination of 35,155 arthroscopic RCR procedures performed over a 7-year study period, Westermann et al[29] reported that patients who filled opioid prescriptions 1 to 3 months before surgery were more likely to be filling opioid prescriptions up to 9 months after surgery.

Similarly, the high utilization of steroid injections within the previous 3 months is also disconcerting. Recent evidence has shown that patients who had steroid injections administered in the 3 months preceding elective shoulder arthroplasty had higher rates of postoperative infections.[28] Further evidence has shown that patients receiving a steroid injection in the month before elective shoulder arthroscopic surgery had a high risk of experiencing infections compared with other preoperative time points.[17] Baverel et al[2] examined the effects of preoperative and postoperative corticosteroid injections on the outcomes of RCR and observed that the latter were associated with lower clinical outcomes and a greater risk of retears. Although the current study does not evaluate postoperative resource utilization and outcomes based on differing time points of preoperative steroid injections, there is a need for further evidence to facilitate a discussion on the overall value of steroid injections as a nonoperative treatment modality before elective arthroscopic RCR.

An important factor influencing the high utilization of health care resources before arthroscopic RCR for atraumatic tears is that most insurance companies mandate a trial of nonoperative interventions before authorizing a surgical procedure. The cost-effectiveness of mandated nonoperative care is beyond the scope of this article. As the health care system moves toward adopting value, understanding patient and clinical characteristics associated with the failure of nonoperative treatment will be an effective way to identify patients who may not benefit from a prolonged trial of nonoperative treatment, thus saving costs for the health care system. Another important dynamic that likely influences the extensive use of nonoperative modalities is the patient-provider relationship. Patients may prefer nonoperative modalities in an effort to avoid an invasive surgical procedure.[4] Shared decision making through the dissemination of knowledge between patients and providers would allow patients to better understand the value of certain nonoperative treatments.[26] It is also plausible that because of delays in scheduling/booking of surgical procedures, providers may overutilize certain nonoperative modalities, such as pain medications and injections, to keep patients appeased until the actual procedure takes place.

There are certain limitations to this study that need to be taken into context when interpreting and translating the results into clinical practice. First, although the HAC database is a comprehensive repository of more than 20 million insured patients across the United States, it represents only patients with commercial and/or MA insurance and therefore may not be nationally representative. Administrative databases, such as the one used for the current study, are prone to coding and/or billing errors that may influence the results. We were unable to account for any regional differences and/or variations in costs across the nation. This study also did not capture patients who underwent open RCR, superior capsular reconstruction, or arthroplasty for rotator cuff arthropathy, among others. The study does not draw conclusions about the cost-effectiveness of certain nonoperative treatment modalities versus operative repair because that is beyond the scope of the article. The lack of granular patient- and/or clinical-level data prevents us from comprehensively analyzing and identifying characteristics of high utilizers. It is also unknown as to whether pain medications (ie, opioids and/or NSAIDs) were being prescribed for rotator cuff problems or other degenerative musculoskeletal disorders commonly seen in the elderly population (ie, hip/knee osteoarthritis). We also did not evaluate the impact of the utilization of nonoperative treatment modalities on outcomes because this was beyond the scope of the study. The database is also composed of Humana-only beneficiaries and therefore does not contain information on patients who may have changed insurance plans and/or used self-pay in the 1-year preoperative period. This is the most plausible reason as to why, in our cohort, 7% to 10% of patients did not have an office visit in the year before surgery or why 12% to 15% of patients did not undergo shoulder radiography to rule out osteoarthritis.

CONCLUSION

Around $900 to $1300 per patient was spent in rotator cuff–related health care resource use in the year prior to undergoing arthroscopic RCR. Despite their negative effects on postoperative outcomes, opioids and steroid injections appeared to be strongly utilized within the 3 months before surgery.

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APPENDIX

List of Codes Associated With Health Care Resource Categories[a]

Health Care Resource Category	Codes
Physical therapy	CPT-97001, CPT-97002, CPT-97003, CPT-97004, CPT-97010, CPT-97012, CPT-97014, CPT-97016, CPT-97018, CPT-97022, CPT-97024, CPT-97026, CPT-97032, CPT-97033, CPT-97034, CPT-97035, CPT-97036, CPT-97039, CPT-97110, CPT-97112, CPT-97113, CPT-97116, CPT-97124, CPT-97139, CPT-97140, CPT-97150, CPT-97161, CPT-97162, CPT-97163, CPT-97164, CPT-97165, CPT-97166, CPT-97530
Office visits	CPT-99201, CPT-99202, CPT-99203, CPT-99204, CPT-99205, CPT-99211, CPT-99212, CPT-99213, CPT-99214, CPT-99215
Steroid injections	CPT-J0702, CPT-J0704, CPT-J1020, CPT-J1030, CPT-J1040, CPT-J1094, CPT-J1100, CPT-J1700, CPT-J1710, CPT-J1720, CPT-J2650, CPT-J2920, CPT-J2930, CPT-J3300, CPT-J3301, CPT-J3302, CPT-J3303 AND CPT-20610, CPT-20611
HA injections	CPT-J3470, CPT-J3471, CPT-J3473, CPT-J7319, CPT-J7321, CPT-J7322, CPT-J7323, CPT-J7324, CPT-J7325, CPT-J7326, CPT-J7327, CPT-Q4083, CPT-Q4084, CPT-Q4085, DRUG-HYALGAN
CT scans	CPT-73200, CPT-73201, CPT-73202, CPT-73206
MRI scans	CPT-73218, CPT-73219, CPT-73220, CPT-73221, CPT-73222, CPT-73223, CPT-73225
X-rays	CPT-73000, CPT-73010, CPT-73020, CPT-73030, CPT-73040, CPT-73050, CPT-73060
Opioids	GENERIC_DRUG-100055, GENERIC_DRUG-100230, GENERIC_DRUG-100504, GENERIC_DRUG-101215, GENERIC_DRUG-100548
NSAIDs	DRUG_CAT-1015, DRUG_CAT-1012
Shoulder pathology/ pain codes	ICD-9-D-71211, ICD-9-D-71221, ICD-9-D-71231, ICD-9-D-71281, ICD-9-D-71291, ICD-9-D-71511, ICD-9-D-71521, ICD-9-D-71531, ICD-9-D-71591, ICD-9-D-71611, ICD-9-D-71661, ICD-9-D-71681, ICD-9-D-71691, ICD-9-D-71801, ICD-9-D-71811, ICD-9-D-71841, ICD-9-D-71851, ICD-9-D-71881, ICD-9-D-71891, ICD-9-D-71901, ICD-9-D-71941, ICD-9-D-71951, ICD-9-D-71981, ICD-9-D-7260, ICD-9-D-7261, ICD-9-D-72611, ICD-9-D-72612, ICD-9-D-72613, ICD-9-D-72619, ICD-9-D-7262, ICD-9-D-72761, ICD-9-D-73341, ICD-9-D-8403, ICD-8404, ICD-9-D-8405, ICD-9-D-8406, ICD-9-D-8407, ICD-9-D-8408, ICD-9-D-8409, ICD-9-D-9592

[a]CPT, Current Procedural Terminology; CT, computed tomography; HA, hyaluronic acid; ICD, International Classification of Diseases; MRI, magnetic resonance imaging; NSAIDs, nonsteroidal anti-inflammatory drugs.