A REPORT TO THE INDUSTRY

# Spinal Fusion Claims in California Workers' Compensation

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MARCH 2017

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## EXECUTIVE SUMMARY

Historically, discussions related to spinal fusion surgery (arthrodesis) in California workers' compensation have centered on the costs associated with implantable hardware and underlying financial incentives that may not have been in the best interest of injured workers. This study examines data from 18,266 California workers' compensation claims from accident years (AY) 2000 through 2014 in which one or more spinal fusions were performed. The Institute undertook this study to expand the discussion of spinal fusion as a surgical treatment option providing long term clinical benefits for injured workers. Among the key findings:

- In more than 60 percent of claims where spinal fusion surgery was performed the initial report of injury was for a sprain or strain. Lumbar fusions accounted for the majority of the spinal fusions.
- More than 30 percent of the spinal fusion surgery codes were for additional vertebral segments (multiple levels of fusion).
- 55 percent of the spinal fusions were associated with diagnoses describing back disorders excluding spinal cord or nerve root involvement.
- 36.8 percent of the spinal fusion claims were also associated with a comorbid mental health disorder and 17.1 percent also showed an associated substance abuse disorder.
- The presence of comorbid conditions significantly increased claim costs for spinal fusion claims compared to spinal fusion claims without comorbid conditions.
- Medical and indemnity costs for injured workers with spinal fusion surgery were higher for males than females.
- The majority of the spinal fusions occurred within the first two years of the injury date.
- As the spinal fusion claims developed over time, more than 20 percent of them -- and up to 40 percent for accident year 2000 claims -- receive more than one spinal fusion.
- Opioid use increased in the months and years after spinal fusion surgery when compared to opioid use prior to surgery.

## BACKGROUND

When spinal fusions were first performed more than 60 years ago, the goal was to stabilize vertebral fractures and deformities such as spinal tuberculosis and scoliosis, but today the majority of spinal fusions are performed to treat degenerative spinal conditions such as disc degeneration, spinal stenosis, and degenerative spondylolisthesis.[1] Research shows, however, that long term clinical outcomes for injured workers undergoing spinal fusion related to disc degeneration are poorer than for other populations and are associated with increases in disability, opiate use and poor return to work status. [2,3]

Recent studies using data obtained from the California Office of Statewide Health Planning and Development (OSHPD) have shown a decline in spinal fusions in California workers' compensation since 2008,[4,5] and as noted in Exhibit 1, the decline in the number of workers' compensation inpatient hospitalizations for spinal fusions continued in 2015, producing a net decline of 29 percent over that 8-year span. However, the volume of all workers' compensation inpatient hospitalizations also declined during that period, so spinal fusions as a percentage of workers' compensation inpatient hospitalizations have remained relatively constant, ranging from a low of 20.5 percent to a high of 23.1 percent.

### Exhibit 1: Volume of Discharges for Implant-Eligible Spinal Surgeries and Percent of Implant-Eligible Spinal Surgeries to All Discharges by Payer Group

| Discharge Year | Medicare | Medi-Cal | Private Coverage | Workers' Comp |
|---|---|---|---|---|
| **2008** | 10,749 (0.9%) | 2,108 (0.2%) | 16,106 (1.2%) | 5,070 (21.0%) |
| **2009** | 12,093 (1.0%) | 2,227 (0.2%) | 16,784 (1.2%) | 4,866 (21.7%) |
| **2010** | 12,670 (1.0%) | 2,417 (0.2%) | 16,787 (1.3%) | 5,193 (23.2%) |
| **2011** | 13,402 (1.0%) | 2,479 (0.2%) | 16,240 (1.3%) | 4,999 (22.6%) |
| **2012** | 14,246 (1.1%) | 2,593 (0.3%) | 16,412 (1.3%) | 4,978 (23.1%) |
| **2013** | 14,903 (1.2%) | 2,730 (0.3%) | 16,175 (1.4%) | 4,559 (22.4%) |
| **2014** | 15,714 (1.3%) | 3,956 (0.3%) | 15,844 (1.4%) | 3,938 (21.2%) |
| **2015** | 16,104 (1.3%) | 4,484 (0.4%) | 15,590 (1.4%) | 3,598 (20.5%) |
| **'08 - '15 Net Change** | **49.8%** | **112.7%** | **-3.2%** | **-29.0%** |

In addition to updating the OSHPD inpatient trends related to spinal fusions, this study uses claims data from CWCI's Industry Research Information System (IRIS) database[6] to take a detailed look at back injury claim experience over the 15-year period spanning accident years 2000 through 2014, examining patient demographics

1. Martin, B.I., et al. (2007). Reoperation Rates Following Lumbar Spine Surgery and the Influence of Spinal Fusion Procedures. *SPINE (32)*3, 382-387.
2. Anderson, J.T., Haas, A.R., Percy, R., Woods, S.T., Ahn, U.M. and Ahn, N.U. (2015, December). Return to Work After Diskogenic Fusion in Workers' Compensation Subjects. *Orthopedics (38)*12, e1065-e1072.
3. Nguyen, T.H., Randolph, D.C., Talmage, J., Succop, T. & Travis, R. Long-term outcomes of lumbar fusion among workers' compensation subjects: a historical cohort study [Abstract]. *SPINE (36)*4. February 2011.
4. Jones, S. and David, R. Inpatient Hospital Utilization in California Workers' Compensation System. CWCI Research Update. December 2014.
5. Jones, S. Inpatient Hospital Utilization in California Workers' Compensation: 2008 – 2014. CWCI Spotlight Report. March 2016.
6. IRIS is CWCI's proprietary database containing data on employee and employer characteristics, medical service data, benefits, and administrative costs on approximately 5 million California workers' compensation claims.

for spinal fusion claims, as well as characteristics such as the nature and cause of injury; the distribution of spinal fusion claims by spinal region, diagnosis, and number of vertebral segments involving spinal hardware; and the presence, types and number of comorbidities. The study also identifies and measures the use of associated services on spinal fusion claims, analyzes the timing and frequency of these surgeries, and compares the average indemnity and medical payments for workers' compensation medical back claims with and without spinal fusions.

## METHODOLOGY

The author queried the IRIS database for claims with at least one spinal arthrodesis code present in the medical payment data. A complete list of codes used for this query can be found in Appendix 1. The data included open and closed claims from accident years 2000 through 2014. Once the spinal fusion claims were identified, characteristics associated with the claim population – including injury characteristics, demographics, notification and payment data -- were extracted. A subset of claims in which the primary diagnosis was for medical back problems without spinal cord involvement was then extracted to serve as a comparison group, and the same claim characteristics that had been identified for the spinal fusion claims was extracted for this claim subset. In addition to the claim data, detailed medical and pharmacy bill data was extracted for the spinal fusion claims. The Current Procedural Terminology (CPT) codes and International Classification of Diseases (ICD-9 and ICD-10) diagnosis codes from this data were used to further define the types of surgery received[7] and any comorbid conditions (e.g., substance abuse) associated with the claim.

7. Exploration of fusion (22830); hardware removal (22850, 22852 & 22855); reinsertion of spinal fixation device (22849); 7-12 vertebral segments fused during surgical event (22843); primary diagnosis of acquired spondylolisthesis (738.4); diagnosis of post-laminectomy syndrome (722.80, 722.81, 722.82, 722.83)

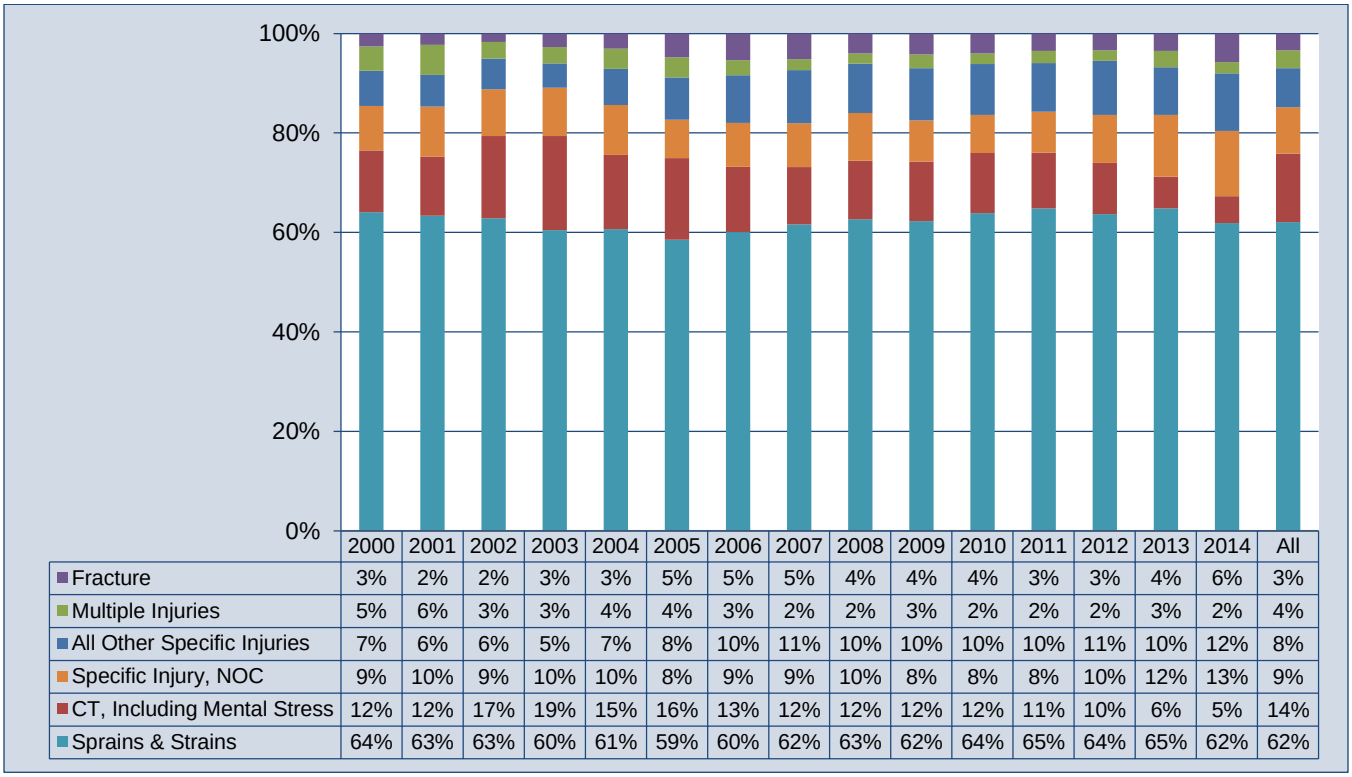
## FINDINGS

### Spinal Fusion Claim Characteristics

The data in Exhibit 2 show that for each of the 15 accident years studied, more than 60 percent (ranging between 61 percent and 65 percent) of claims with at least one spinal fusion surgery in the medical record were initially reported as a sprain or strain injury. Claims in which the nature of injury was identified as a cumulative trauma (CT) represented 14 percent of the claims with spinal fusion surgery. As noted, CWCI's 2016 study on California workers' compensation CT claims found that on average, CT claims are reported to the employer 258 days post injury, therefore, the relatively low proportions of CT claims noted for AY 2013 and 2014 can be expected to increase over time.[8]

### Exhibit 2: Distribution of Spinal Fusion Claims by Nature of Injury

### AY 2000 - 2014 Claims



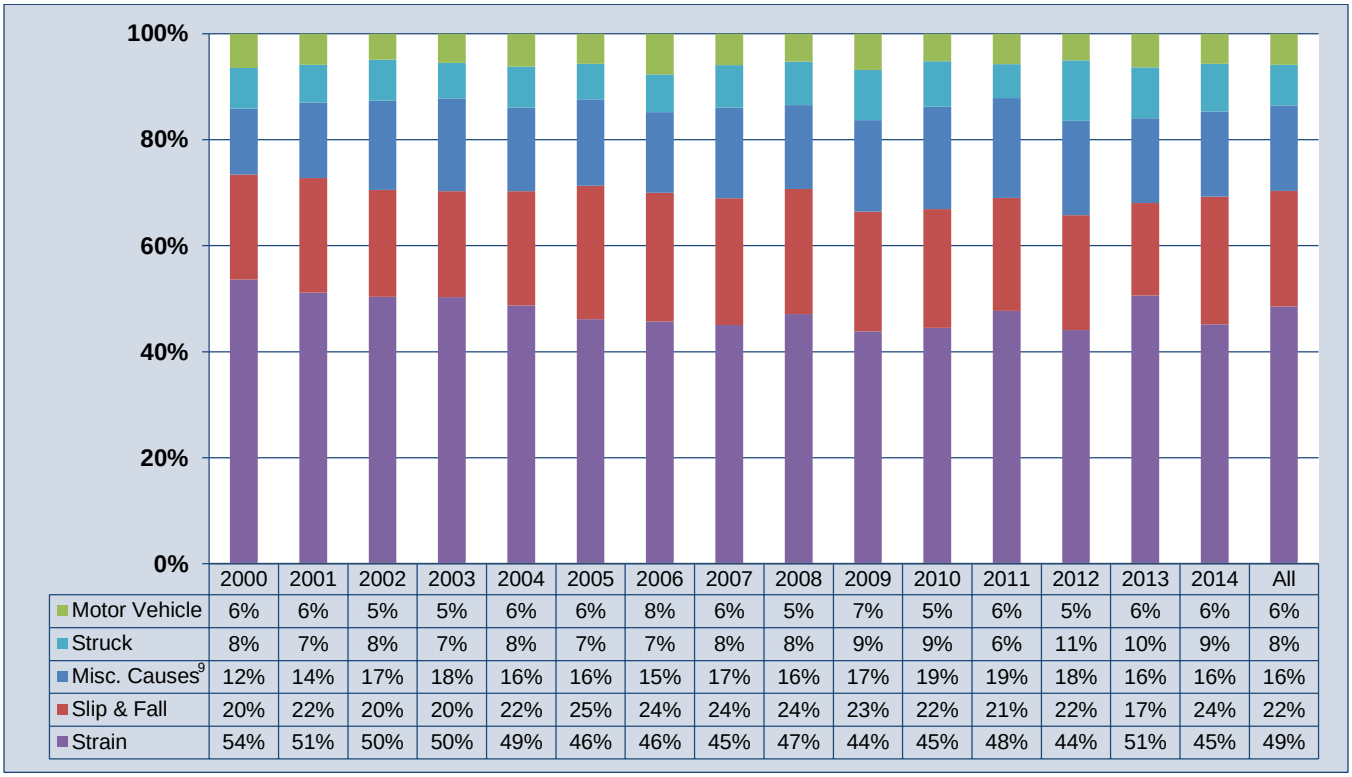

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fracture | 3% | 2% | 2% | 3% | 3% | 5% | 5% | 5% | 4% | 4% | 4% | 3% | 3% | 4% | 6% | 3% |
| Multiple Injuries | 5% | 6% | 3% | 3% | 4% | 4% | 3% | 2% | 2% | 3% | 2% | 2% | 2% | 3% | 2% | 4% |
| All Other Specific Injuries | 7% | 6% | 6% | 5% | 7% | 8% | 10% | 11% | 10% | 10% | 10% | 10% | 11% | 10% | 12% | 8% |
| Specific Injury, NOC | 9% | 10% | 9% | 10% | 10% | 8% | 9% | 9% | 10% | 8% | 8% | 8% | 10% | 12% | 13% | 9% |
| CT, Including Mental Stress | 12% | 12% | 17% | 19% | 15% | 16% | 13% | 12% | 12% | 12% | 12% | 11% | 10% | 6% | 5% | 14% |
| Sprains & Strains | 64% | 63% | 63% | 60% | 61% | 59% | 60% | 62% | 63% | 62% | 64% | 65% | 64% | 65% | 62% | 62% |

8. Jones, S., David, R.B., Hayes, S. *Cumulative Trauma in California Workers' Compensation*. CWCI Research Note. December 2016.

Exhibit 3 shows the distribution of spinal fusion claims by the reported cause of injury in each of the 15 years studied. Over the entire study period, roughly half of the claims with at least one spinal fusion surgery resulted from some type of strain. The results broken out by individual accident year show fairly wide variation in the percentage of spinal fusion claims caused by stains, ranging from a low of 44 percent in AY 2012 to a high of 54 percent in AY 2000. Slip and fall accidents were the second leading cause of injury for injured workers undergoing spinal fusions, accounting for 22 percent of claims across the entire 15-year span, with results for individual years ranging from 17 percent of the claims in AY in AY 2013 to a high of 25 percent of the claims in AY 2005.

### Exhibit 3: Distribution of Spinal Fusion Claims by Cause of Injury

### AY 2000 - AY 2014 Claims



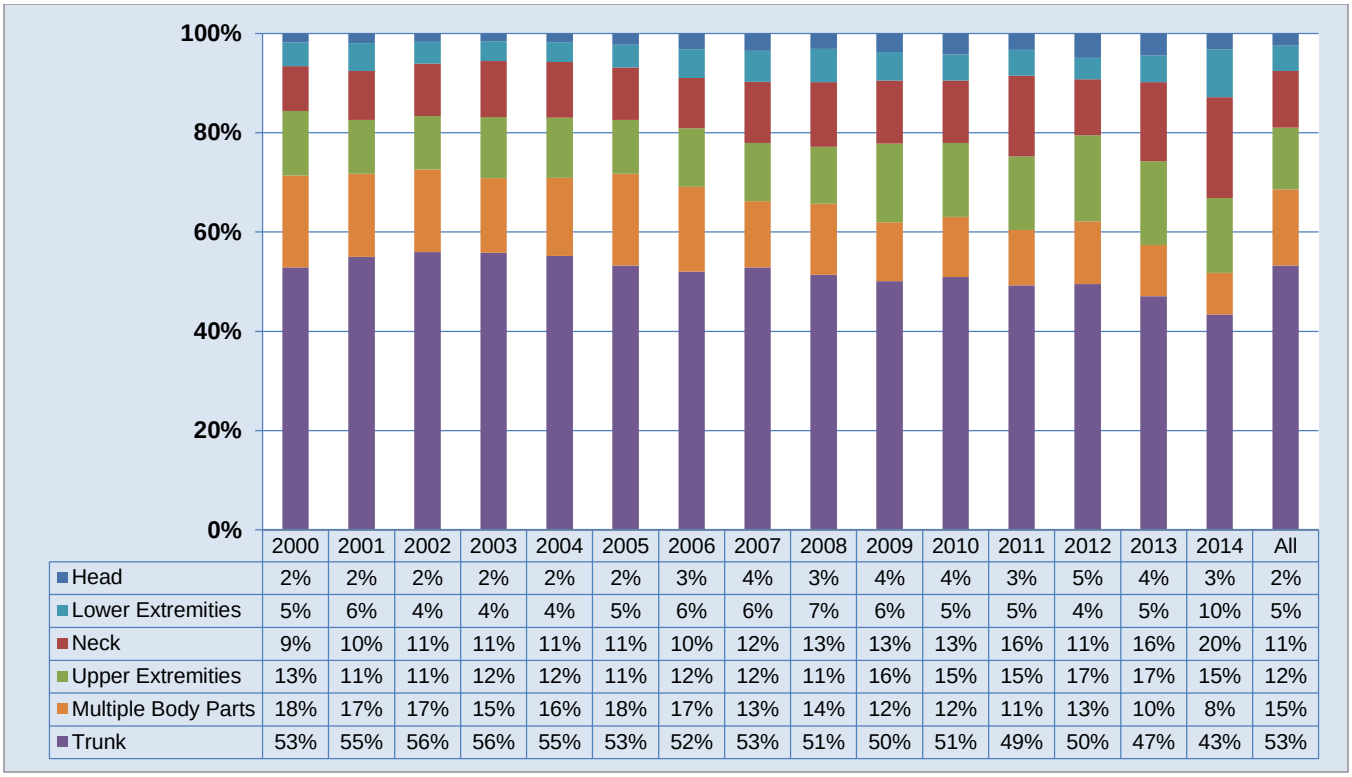

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor Vehicle | 6% | 6% | 5% | 5% | 6% | 6% | 8% | 6% | 5% | 7% | 5% | 6% | 5% | 6% | 6% | 6% |
| Struck | 8% | 7% | 8% | 7% | 8% | 7% | 7% | 8% | 8% | 9% | 9% | 6% | 11% | 10% | 9% | 8% |
| Misc. Causes[9] | 12% | 14% | 17% | 18% | 16% | 16% | 15% | 17% | 16% | 17% | 19% | 19% | 18% | 16% | 16% | 16% |
| Slip & Fall | 20% | 22% | 20% | 20% | 22% | 25% | 24% | 24% | 24% | 23% | 22% | 21% | 22% | 17% | 24% | 22% |
| Strain | 54% | 51% | 50% | 50% | 49% | 46% | 46% | 45% | 47% | 44% | 45% | 48% | 44% | 51% | 45% | 49% |

9. Miscellaneous cause of injury consists primarily of claims reported as “miscellaneous – not otherwise classified” and “cumulative – not otherwise classified.”

The distribution of spinal fusion claims by injured body part is shown in Exhibit 4, with distributions noted for each accident year as well as the overall distribution for the entire 15-year study period. The trunk was listed as the most frequently injured body part in the spinal fusion claims, accounting for 53 percent of all claims in the sample, with results by individual accident year ranging from 50 percent to 56 percent across the 15-year study period (Exhibit 4). Head injuries and injuries involving the lower extremities represented the smallest share of the spinal fusion claim population, with head injuries listed as the injured body part in just 2 percent of all AY 2000 – 2014 spinal fusion claims (ranging from 2 percent to 5 percent among the individual accident years) while lower extremity injuries accounted for 5 percent of the claims overall, ranging from between 4 percent and 10 percent of the claims (Exhibit 4).

### Exhibit 4: Distribution of Spinal Fusion Claims by Injured Body Part

### AY 2000 - AY 2014 Claims



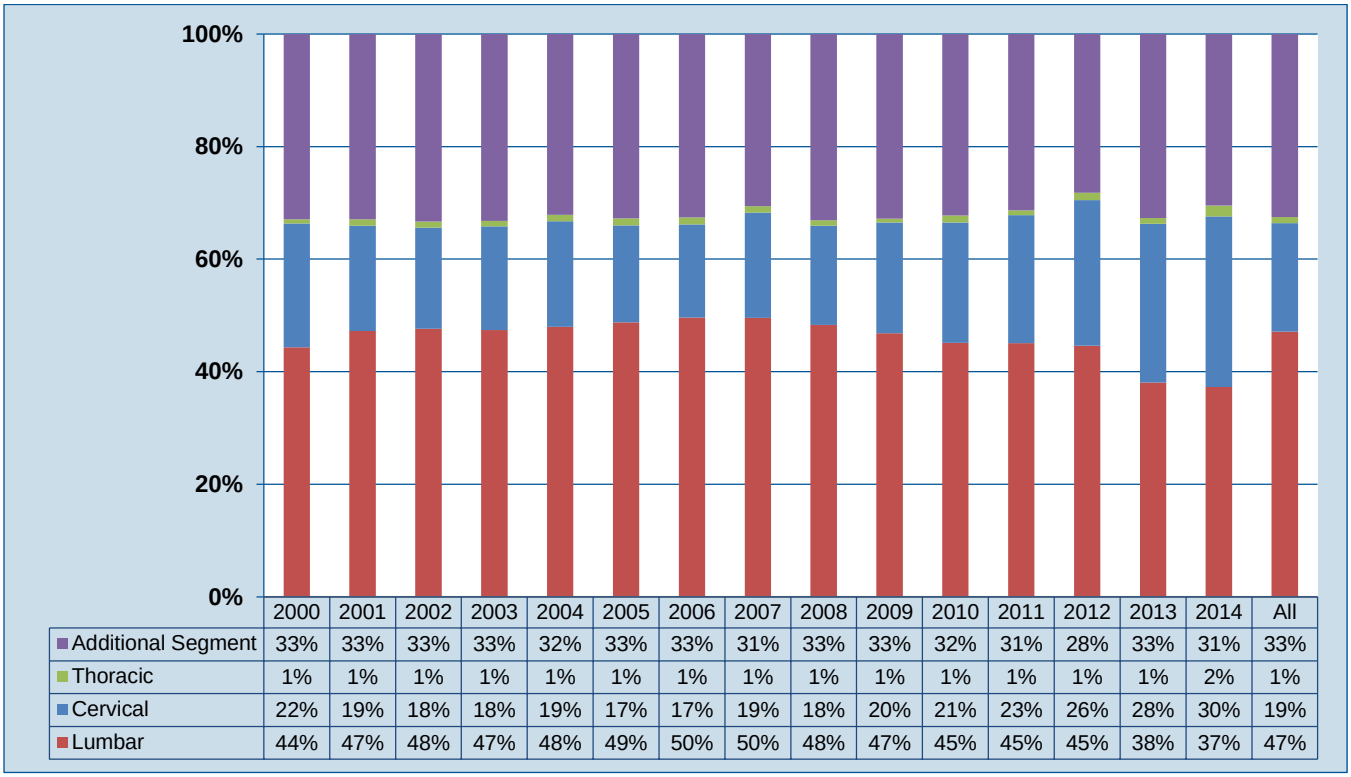

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Head | 2% | 2% | 2% | 2% | 2% | 2% | 3% | 4% | 3% | 4% | 4% | 3% | 5% | 4% | 3% | 2% |
| Lower Extremities | 5% | 6% | 4% | 4% | 4% | 5% | 6% | 6% | 7% | 6% | 5% | 5% | 4% | 5% | 10% | 5% |
| Neck | 9% | 10% | 11% | 11% | 11% | 11% | 10% | 12% | 13% | 13% | 13% | 16% | 11% | 16% | 20% | 11% |
| Upper Extremities | 13% | 11% | 11% | 12% | 12% | 11% | 12% | 12% | 11% | 16% | 15% | 15% | 17% | 17% | 15% | 12% |
| Multiple Body Parts | 18% | 17% | 17% | 15% | 16% | 18% | 17% | 13% | 14% | 12% | 12% | 11% | 13% | 10% | 8% | 15% |
| Trunk | 53% | 55% | 56% | 56% | 55% | 53% | 52% | 53% | 51% | 50% | 51% | 49% | 50% | 47% | 43% | 53% |

The distribution of spinal fusion procedures by spinal region has varied over time. Exhibit 5 shows that fusions involving lumbar vertebrae have consistently represented the largest share (47 percent) of these surgical procedures, though that proportion has ranged from a low of 37 percent in AY 2014 to a high of 50 percent in AY 2006 and AY 2007. There appears to be a slight shift in the overall mix of spinal fusion procedures by spinal region beginning with AY 2012 claims, with cervical fusions representing a growing proportion of the fusion claims in 2012, 2013 and 2014, while lumbar fusions represented a declining proportion.

The relatively high proportion (33 percent) of arthrodesis codes that describe an additional segment is indicative of spinal fusion procedures that involve multiple levels of fusion (e.g., L2-L3 segment & L3-L4 segment).

### Exhibit 5: Distribution of Spinal Fusion Procedures by Spinal Region

### AY 2000 - AY 2014 Claims

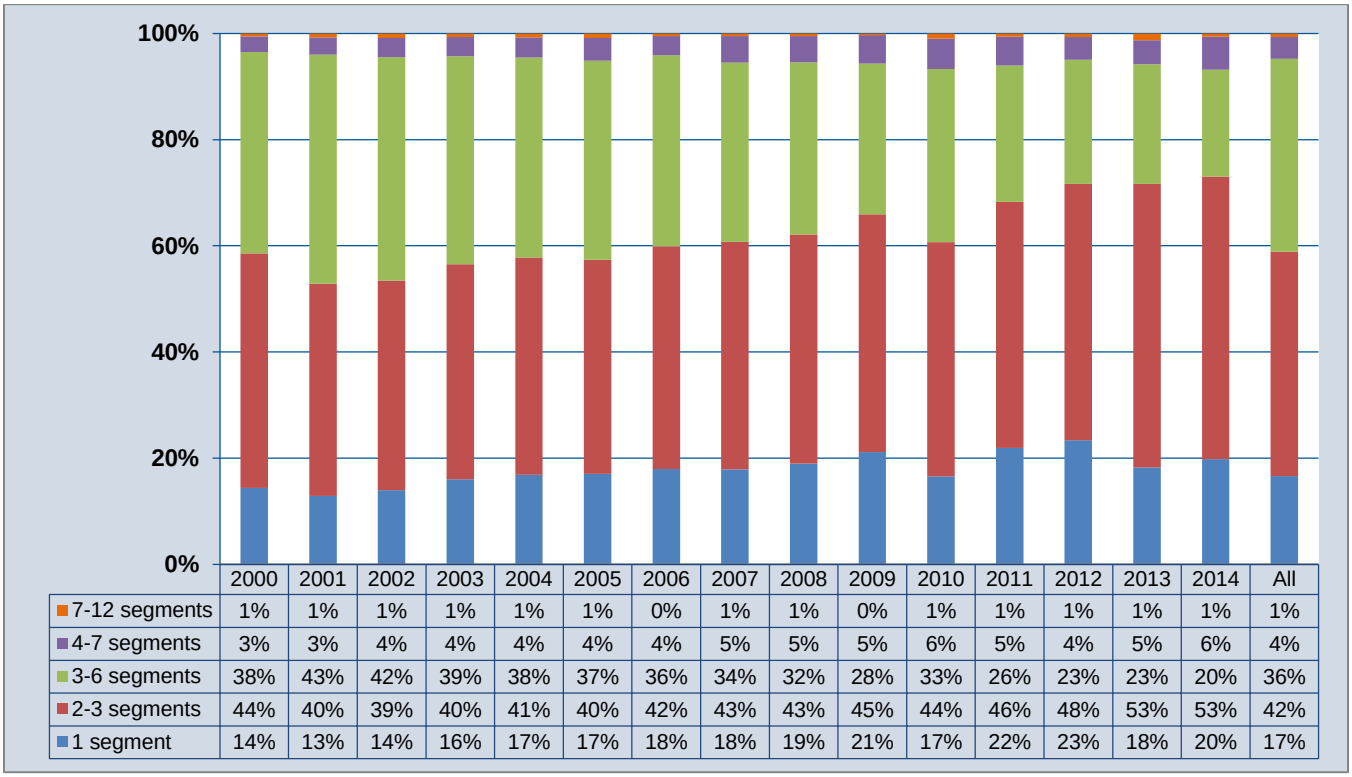



| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Additional Segment | 33% | 33% | 33% | 33% | 32% | 33% | 33% | 31% | 33% | 33% | 32% | 31% | 28% | 33% | 31% | 33% |
| Thoracic | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 2% | 1% |
| Cervical | 22% | 19% | 18% | 18% | 19% | 17% | 17% | 19% | 18% | 20% | 21% | 23% | 26% | 28% | 30% | 19% |
| Lumbar | 44% | 47% | 48% | 47% | 48% | 49% | 50% | 50% | 48% | 47% | 45% | 45% | 45% | 38% | 37% | 47% |

The number of vertebral segments that are subject to implantation of spinal hardware during a surgical session varies depending on whether the instrumentation is applied anteriorly or posteriorly (see Appendix 1 for complete code descriptions). Exhibit 6 provides information related to the number of vertebral segments subject to implantation of spinal hardware in a surgical session for the AY 2000 through AY 2014 claims in the study sample.

### Exhibit 6: Distribution of Spinal Fusion Claims by Number of Vertebral Segments Involving Instrumentation

### AY 2000 - AY 2014 Claims

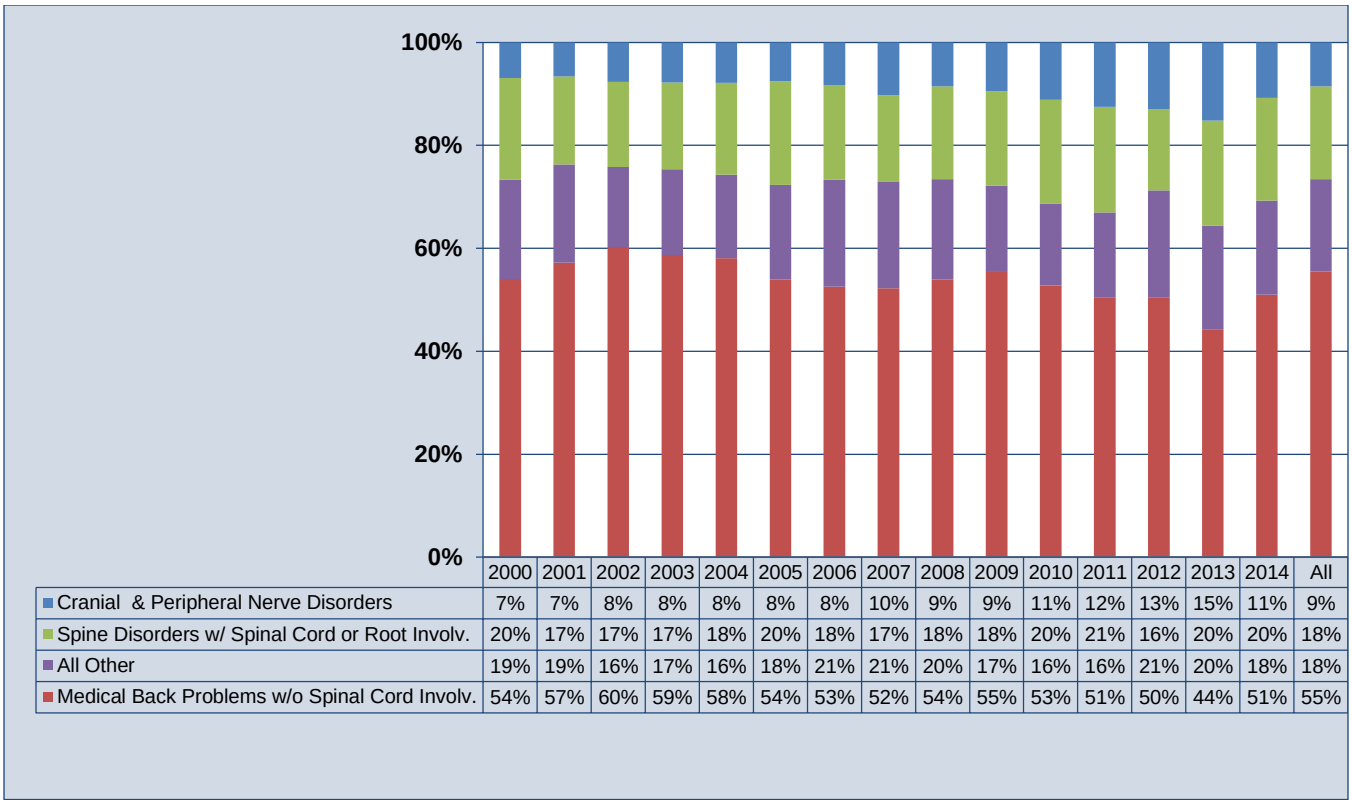



| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7-12 segments | 1% | 1% | 1% | 1% | 1% | 1% | 0% | 1% | 1% | 0% | 1% | 1% | 1% | 1% | 1% | 1% |
| 4-7 segments | 3% | 3% | 4% | 4% | 4% | 4% | 4% | 5% | 5% | 5% | 6% | 5% | 4% | 5% | 6% | 4% |
| 3-6 segments | 38% | 43% | 42% | 39% | 38% | 37% | 36% | 34% | 32% | 28% | 33% | 26% | 23% | 23% | 20% | 36% |
| 2-3 segments | 44% | 40% | 39% | 40% | 41% | 40% | 42% | 43% | 43% | 45% | 44% | 46% | 48% | 53% | 53% | 42% |
| 1 segment | 14% | 13% | 14% | 16% | 17% | 17% | 18% | 18% | 19% | 21% | 17% | 22% | 23% | 18% | 20% | 17% |

As shown in Exhibit 7, the number one diagnostic category associated with AY 2000-2014 spinal fusion claims, was "medical back problems without spinal cord involvement" (medical back), which includes diagnoses describing medical back disorders excluding spinal cord or nerve root involvement. Overall, these medical back cases accounted for 55 percent of all spinal fusion claims over the 15-year span of the study, with results for individual years ranging between 44 percent of the AY 2013 claims to 60 percent of the AY 2002 claims. Addressing diagnoses included in the medical back category authors of the MD Guidelines state that terms such as "'degenerative disc disease,' 'discogenic back pain,' 'black disc disease,' 'micro instability,' and 'lumbar spondylosis' are used interchangeably to describe the same group of patients with chronic LBP [low back pain] in whom the pain generating structure is not defined."[10]

## Exhibit 7: Distribution of Spinal Fusion Claims by Diagnostic Category

## AY 2000 - AY 2014 Claims




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cranial & Peripheral Nerve Disorders | 7% | 7% | 8% | 8% | 8% | 8% | 8% | 10% | 9% | 9% | 11% | 12% | 13% | 15% | 11% | 9% |
| Spine Disorders w/ Spinal Cord or Root Involv. | 20% | 17% | 17% | 17% | 18% | 20% | 18% | 17% | 18% | 18% | 20% | 21% | 16% | 20% | 20% | 18% |
| All Other | 19% | 19% | 16% | 17% | 16% | 18% | 21% | 21% | 20% | 17% | 16% | 16% | 21% | 20% | 18% | 18% |
| Medical Back Problems w/o Spinal Cord Involv. | 54% | 57% | 60% | 59% | 58% | 54% | 53% | 52% | 54% | 55% | 53% | 51% | 50% | 44% | 51% | 55% |

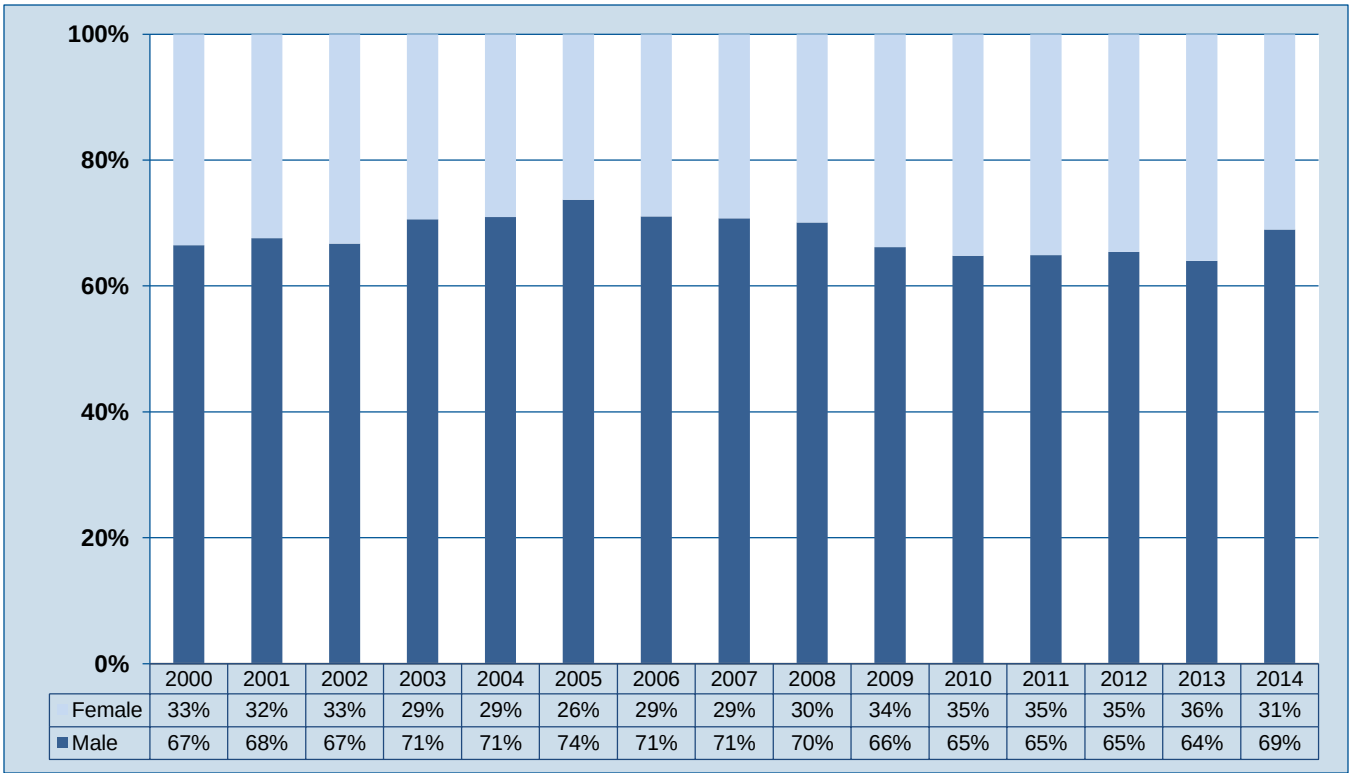
10. The Reed Group. http://www.mdguidelines.com

**Demographic Profile**

In addition to injury characteristics, the author analyzed injured worker characteristics for the study population. In each of the 15 accident years covered by the study, male workers represented at least 64 percent of the injured workers who underwent spinal surgery (Exhibit 8). Beginning with AY 2009 claims, the proportion of women in the spinal fusion population increased slightly, but that proportion dipped back down to pre-2009 levels in AY 2014.

### Exhibit 8: Distribution of Spinal Fusion Claims by Gender

### AY 2000 - AY 2014




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Female | 33% | 32% | 33% | 29% | 29% | 26% | 29% | 29% | 30% | 34% | 35% | 35% | 35% | 36% | 31% |
| Male | 67% | 68% | 67% | 71% | 71% | 74% | 71% | 71% | 70% | 66% | 65% | 65% | 65% | 64% | 69% |

The average age of injured workers with spinal fusions was higher than the average for injured workers with other types of indemnity claims across all 15 of the accident years analyzed, with the differential increasing over time as shown in Exhibit 9. The average age associated with spinal fusion claims showed a 10.5 percent increase from AY 2000 to AY 2014, while all other indemnity claims (excluding spinal fusions) showed a smaller increase of 3.8 percent.

Exhibit 9 also shows that the average job tenure of injured workers who underwent spinal fusions was longer than that of injured workers with other types of indemnity claims, ranging from a low of 5 years with the at-injury employer for AY 2000 claims to a high of 8.8 years for AY 2013 claims. In contrast, average employment tenure for all other indemnity claims ranged from a low 4.4 years for AY 2001 and 2002 claims to a high of 6.5 years for AY 2012 claims.

### Exhibit 9: Injured Worker's Average Age & Tenure with Employer at Injury Date Spinal Fusion Claims Vs. All Other Claims

### AY 2000 – AY 2014

| | Spinal Fusion Claims | | All Other Indemnity Claims | |
|---|---|---|---|---|
| **AY** | **Average Age** | **Average Tenure** | **Average Age** | **Average Tenure** |
| **2000** | 41.6 | 5.0 | 38.9 | 4.7 |
| **2001** | 42.1 | 4.6 | 39.1 | 4.4 |
| **2002** | 42.5 | 4.7 | 39.3 | 4.4 |
| **2003** | 42.8 | 5.0 | 39.5 | 4.6 |
| **2004** | 42.8 | 5.3 | 39.2 | 4.6 |
| **2005** | 43.0 | 5.4 | 39.5 | 4.6 |
| **2006** | 43.3 | 5.6 | 40.3 | 4.9 |
| **2007** | 44.7 | 5.7 | 41.3 | 5.0 |
| **2008** | 44.9 | 6.4 | 41.4 | 5.4 |
| **2009** | 45.0 | 6.4 | 41.6 | 5.9 |
| **2010** | 46.2 | 7.8 | 41.5 | 6.3 |
| **2011** | 46.7 | 8.0 | 41.3 | 6.4 |
| **2012** | 46.0 | 7.6 | 40.9 | 6.5 |
| **2013** | 46.8 | 8.8 | 40.9 | 6.3 |
| **2014** | 46.2 | 7.8 | 41.3 | 5.9 |
| **Overall Average** | **43.5** | **5.6** | **40.4** | **5.3** |

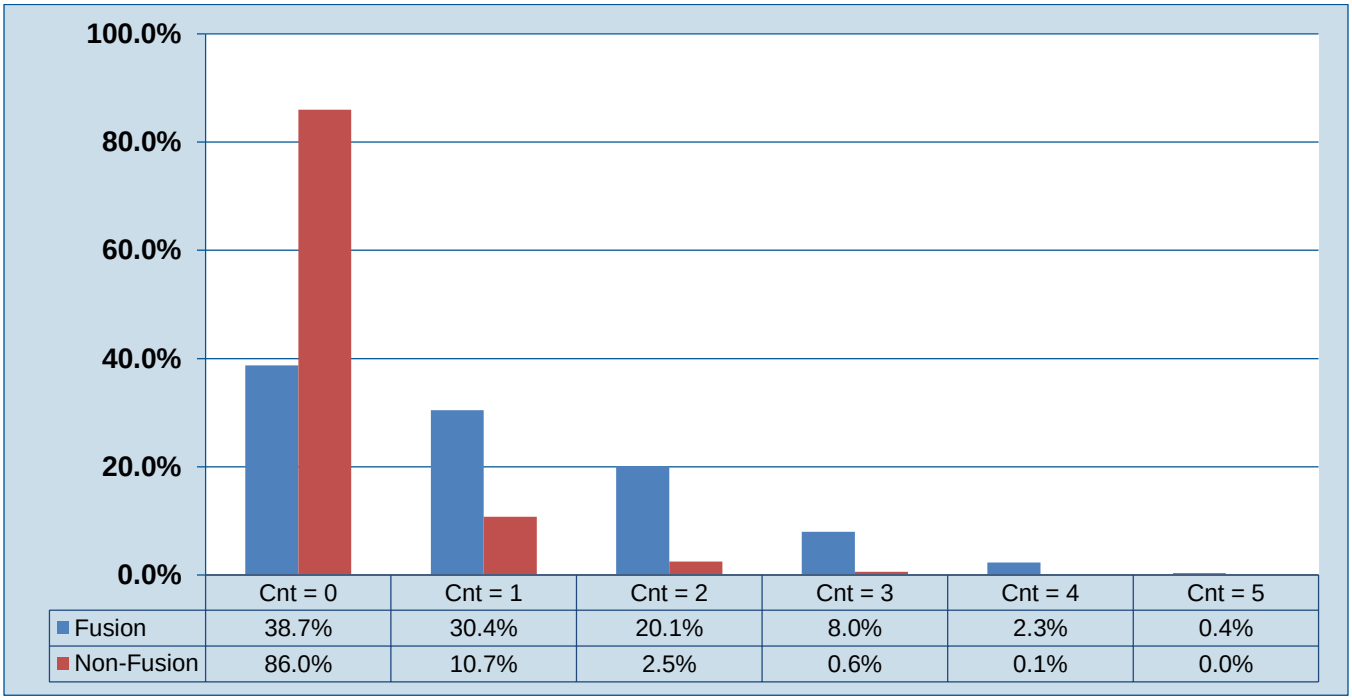
**Comorbidities**

The presence of comorbid conditions can make a claim more complex, affect the timing and types of treatment rendered, and increase the duration and cost of the claim. To measure the presence of comorbid conditions in spinal fusion claims, the author used the International Classification of Disease (ICD) codes associated with paid medical bills to identify claims in the study population that involved any condition that fell into any of five distinct comorbidity categories: metabolic (e.g., diabetes), circulatory (e.g., hypertension, pericardial disease), mental disorders (e.g., depression and anxiety disorders), substance abuse, and obesity.

The frequency with which comorbidity was present on a claim was calculated for spinal fusion claims in the medical back category, as well as for medical back claims where there was no record of a spinal fusion. The results for the entire 15-year study period, noted in Exhibit 10, show the frequency of comorbid conditions differed significantly between the spinal fusion and non-spinal fusion subpopulations, with only about 1 in 7 (14 percent) of the non-fusion claims having at least one comorbidity, compared to more than 6 in 10 (61.3 percent) of the spinal fusion claims.

Appendix 2 includes exhibits showing the average number of comorbidities present for spinal fusion and for non-fusion claims as a percent of all medical back claims for all 15 years included in the study. The data suggest that the presence of comorbid conditions for spinal fusion patients may increase as the injured worker and his or her workers' compensation claim ages, with newer claims with accident dates in 2013 and 2014 showing closer correlation between fusion and non-fusion claims. The lower proportions in newer claims may be a result of compounding health issues, such as weight gain, depression and/or anxiety and opioid use as sequelae to the fusion(s) or it may be associated with physicians submitting bills that capture comorbid conditions as time passes.

### Exhibit 10: Number of Comorbidities per Claim as Percent of Fusion and Non-Fusion Claims
### AY 2000 - AY 2014 Claims

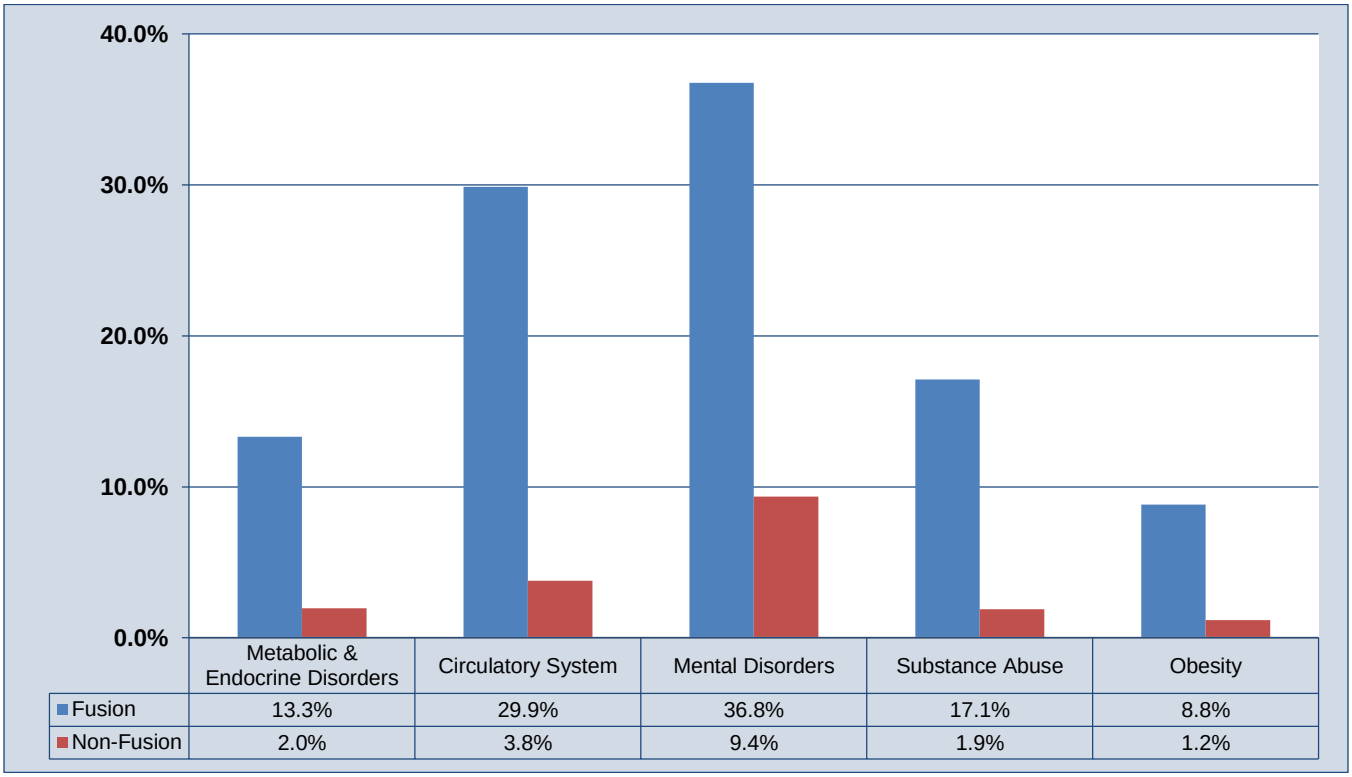



| | Cnt = 0 | Cnt = 1 | Cnt = 2 | Cnt = 3 | Cnt = 4 | Cnt = 5 |
|---|---|---|---|---|---|---|
| Fusion | 38.7% | 30.4% | 20.1% | 8.0% | 2.3% | 0.4% |
| Non-Fusion | 86.0% | 10.7% | 2.5% | 0.6% | 0.1% | 0.0% |

Exhibit 11 compares the proportion of each of the defined comorbid conditions for the fusion and non-fusion medical back claims. Each of the comorbid conditions was more prevalent in the spinal fusion claim population, with mental disorders and circulatory system disorders accounting for the highest proportions. Substance abuse in the spinal fusion population, as indicated by the diagnostic codes) occurs at a significant rate, which is likely related to prolonged use of opioids. (The underlying detail data for each of the accident years can be found in Appendix 2.)

### Exhibit 11: Percent of Fusion and Non-Fusion Claims w/Comorbid Condition - Diagnostic Category Medical Back

### AY 2000 - AY 2014 Claims




| | Metabolic & Endocrine Disorders | Circulatory System | Mental Disorders | Substance Abuse | Obesity |
|---|---|---|---|---|---|
| Fusion | 13.3% | 29.9% | 36.8% | 17.1% | 8.8% |
| Non-Fusion | 2.0% | 3.8% | 9.4% | 1.9% | 1.2% |

**Average Payments**

In addition to determining the basic demographic data related to gender, the author also calculated the average indemnity and medical payments on spinal fusion claims for men and women, with results broken out by accident year. Exhibit 12 shows the average temporary and permanent disability payments, as well as the average medical payments for the accident year 2000 through 2014 claims with spinal fusion procedures. In each category, average amounts paid were higher for males than for females: with TD payments over the 15-year span averaging 15.5 percent more, PD payments averaging 27.1 percent more, and medical payments averaging 16 percent more. The lower amounts paid on claims from the most recent accident years largely reflect the age of the claims, as there has been less time for expenses to accrue on these newer claims

### Exhibit 12: Average TD, PD and Medical Payments for Spinal Fusion Claims by Gender and Accident Year

### AY 2000 – AY 2014 Claims

| | Average TD Paid | | Average PD Paid | | Average Medical Paid | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| **2000** | $56,775 | $52,358 | $68,436 | $56,540 | $222,278 | $194,662 |
| **2001** | $60,997 | $51,729 | $62,199 | $49,088 | $230,860 | $212,344 |
| **2002** | $57,393 | $56,955 | $56,013 | $53,867 | $226,212 | $205,478 |
| **2003** | $67,854 | $59,689 | $75,211 | $51,870 | $242,905 | $200,392 |
| **2004** | $46,018 | $39,143 | $69,062 | $49,326 | $222,728 | $193,286 |
| **2005** | $38,137 | $26,165 | $78,164 | $42,900 | $247,701 | $175,771 |
| **2006** | $38,897 | $28,535 | $70,106 | $62,131 | $234,474 | $197,435 |
| **2007** | $39,339 | $27,611 | $70,768 | $52,717 | $254,757 | $200,624 |
| **2008** | $42,328 | $32,480 | $54,154 | $47,520 | $226,284 | $215,579 |
| **2009** | $44,144 | $33,871 | $49,712 | $39,688 | $188,348 | $219,646 |
| **2010** | $42,750 | $34,582 | $46,650 | $34,481 | $198,516 | $165,468 |
| **2011** | $44,816 | $35,015 | $36,140 | $25,565 | $200,373 | $139,564 |
| **2012** | $40,926 | $36,508 | $28,007 | $19,755 | $157,084 | $112,623 |
| **2013** | $42,537 | $34,680 | $14,422 | $11,420 | $100,884 | $85,356 |
| **2014** | $34,744 | $23,880 | $10,412 | $3,384 | $138,280 | $70,427 |

To get a sense of the average amounts paid on claims of injured workers with similar diagnoses who did not undergo spinal fusion surgery, the author extracted payment data for claims by injured workers with "medical back problems without spinal cord involvement." As was noted in Exhibit 7, this diagnostic category accounted for more than 50 percent of the spinal fusion claims.

This subset of claims was further refined by the inclusion of claims for which indemnity benefits were paid. Exhibit 13 shows the average amounts paid for medical, TD, PD and overall for claims from each accident year, and as in Exhibit 12, the lower amounts paid on the newer claims largely reflect the age of the claims. The data for medical back claims was further broken out by claims where a spinal fusion was present in the medical payment data and claims without a spinal fusion procedure.

### Exhibit 13: Average Payments for Indemnity Claims with Diagnostic Category "Medical Back" AY 2000 – AY 2014 Claims

| | With Spinal Fusion | | | | Without Spinal Fusion | | | |
|---|---|---|---|---|---|---|---|---|
| | AvgMedical | AvgTD | AvgPD | AvgClaim | AvgMedical | AvgTD | AvgPD | AvgClaim |
| **2000** | $197,922 | $58,054 | $64,154 | $349,928 | $24,487 | $8,331 | $14,012 | $55,646 |
| **2001** | $207,667 | $58,965 | $54,179 | $348,781 | $25,418 | $8,800 | $12,386 | $55,143 |
| **2002** | $201,578 | $58,471 | $55,248 | $343,376 | $24,816 | $8,690 | $12,156 | $54,296 |
| **2003** | $214,965 | $67,481 | $65,202 | $378,392 | $24,868 | $8,815 | $13,273 | $56,319 |
| **2004** | $202,933 | $45,170 | $56,178 | $327,882 | $20,859 | $7,836 | $10,611 | $44,521 |
| **2005** | $209,298 | $35,428 | $62,519 | $333,900 | $21,203 | $7,826 | $8,546 | $42,944 |
| **2006** | $218,595 | $35,278 | $66,423 | $351,746 | $22,888 | $8,255 | $9,255 | $46,846 |
| **2007** | $206,799 | $34,729 | $55,284 | $325,690 | $26,239 | $8,576 | $10,362 | $52,274 |
| **2008** | $208,905 | $39,666 | $46,847 | $317,652 | $28,986 | $9,749 | $11,411 | $57,920 |
| **2009** | $187,371 | $40,802 | $44,608 | $296,290 | $31,495 | $10,902 | $12,002 | $62,906 |
| **2010** | $178,301 | $40,354 | $43,432 | $283,597 | $31,387 | $10,918 | $11,217 | $61,888 |
| **2011** | $157,956 | $41,916 | $33,200 | $250,637 | $28,116 | $10,774 | $9,761 | $56,513 |
| **2012** | $130,236 | $39,031 | $19,149 | $201,490 | $25,746 | $11,416 | $9,008 | $53,485 |
| **2013** | $99,063 | $40,379 | $11,016 | $161,764 | $20,198 | $11,002 | $6,670 | $44,086 |
| **2014** | $81,861 | $33,868 | $3,929 | $124,485 | $13,977 | $9,969 | $4,317 | $32,423 |

As noted earlier in this report, comorbid conditions are more prevalent in spinal fusion claims than in non-fusion claims, and comorbidities have been shown to increase workers' compensation claim costs as reported in a 2012 National Council on Compensation Insurance (NCCI) study.[11]

To quantify this payment differential, the author calculated the average medical and indemnity payments for spinal fusion claims based on whether or not one or more comorbid conditions appeared in the medical data. Exhibit 14 compares the average amounts paid for spinal fusion claims in which there were no comorbid conditions to those for spinal fusion claims with one or more comorbid conditions. Although claims associated with newer accident dates have had less time to develop and therefore have lower medical and indemnity payments than more developed claims, the comparisons within each accident year are relevant for the analysis of the impact of comorbidities on cost. The results show that in each accident year, average medical and indemnity payments for spinal fusion claims with comorbid conditions were significantly higher than for spinal fusion claims without comorbidities.

### Exhibit 14: Average Medical and Indemnity Payments for Spinal Fusion Claims With and Without Comorbidity

### AY 2000 – AY 2014 Claims

| | Comorbidity > 0 | | No Comorbidity | |
|---|---|---|---|---|
| **AY** | **Medical** | **Indemnity** | **Medical** | **Indemnity** |
| **2000** | $302,676 | $196,279 | $116,371 | $82,895 |
| **2001** | $312,340 | $181,578 | $111,434 | $83,201 |
| **2002** | $285,403 | $166,399 | $113,864 | $85,553 |
| **2003** | $285,692 | $194,807 | $120,048 | $92,247 |
| **2004** | $255,272 | $148,115 | $130,694 | $78,386 |
| **2005** | $275,280 | $146,646 | $129,281 | $70,390 |
| **2006** | $262,725 | $145,818 | $141,175 | $77,841 |
| **2007** | $281,258 | $139,836 | $150,902 | $85,942 |
| **2008** | $270,652 | $127,197 | $134,026 | $71,771 |
| **2009** | $224,595 | $109,180 | $148,543 | $82,251 |
| **2010** | $220,485 | $108,170 | $131,782 | $71,459 |
| **2011** | $230,733 | $93,821 | $123,601 | $73,837 |
| **2012** | $180,072 | $78,510 | $113,457 | $61,195 |
| **2013** | $104,936 | $59,138 | $92,005 | $55,772 |
| **2014** | $99,633 | $44,361 | $116,354 | $41,002 |

11. Laws, D. and Colon D. *Comorbidities in Workers' Compensation*. NCCI Research Brief. October 2012.

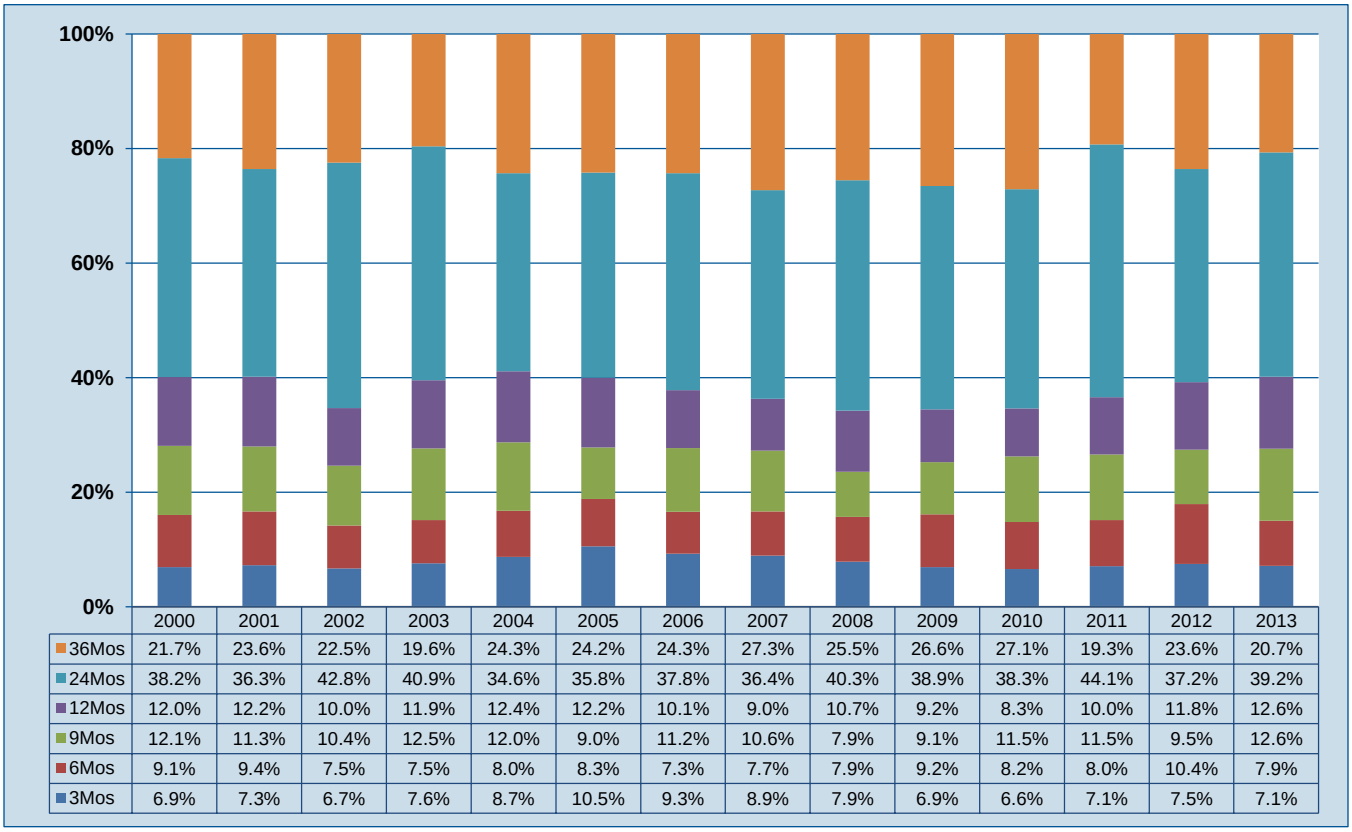
### Timing and Frequency of Spinal Fusions

A number of factors can affect when within the life of a workers' compensation claim a spinal fusion surgery takes place, as well as the total number and frequency of such surgeries within a claim. Among these factors are the nature and extent of the injury, the other types of treatment that have been rendered, the injured worker's age, occupation and motivation to return to work, and the presence of comorbidities.

To analyze when in the life of a claim spinal fusion surgery occurs the author first limited the subset of claims to include only claims that had an opportunity to develop for three years post injury. The number of days between the date of injury and the first spinal fusion was calculated for each claim, and those results were grouped into one of 6 time periods: 3, 6, 9, 12, 24 and 36 months post injury. Exhibit 15 shows the percentage of claims by accident year where the first spinal fusion fell within the defined time periods. There was little variation between accident years in terms of the timing of the first spinal fusion surgery, with between 34.2 percent and 41.1 percent of claims showing the initial spinal fusion occurred within the first year of injury, and between 34.6 percent and 44.1 percent showing the first spinal fusion occurred during the second year post injury.

**Exhibit 15: Timing of 1st Spinal Fusion**
**Claims with Spinal Fusion Within 36 Months of Injury**

**AY 2000 – AY 2013 Claims**

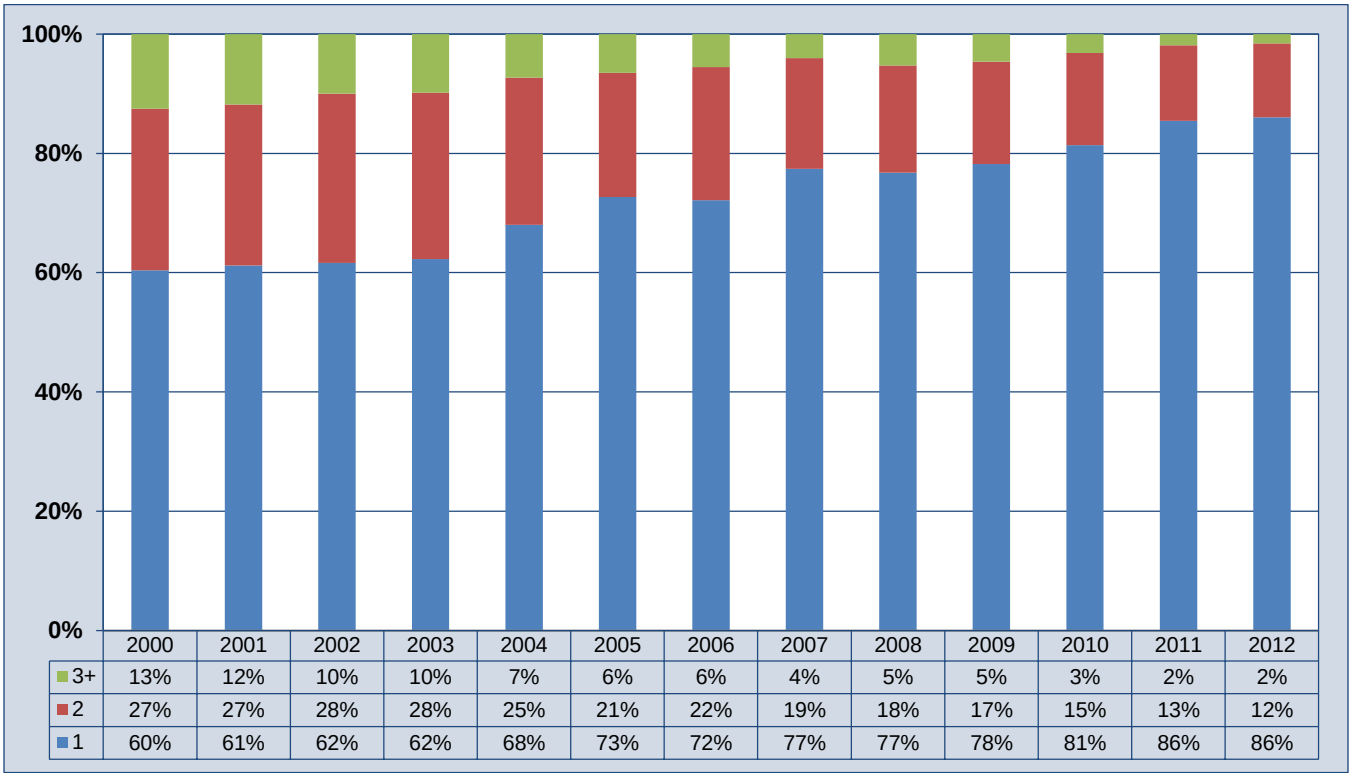



| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36Mos | 21.7% | 23.6% | 22.5% | 19.6% | 24.3% | 24.2% | 24.3% | 27.3% | 25.5% | 26.6% | 27.1% | 19.3% | 23.6% | 20.7% |
| 24Mos | 38.2% | 36.3% | 42.8% | 40.9% | 34.6% | 35.8% | 37.8% | 36.4% | 40.3% | 38.9% | 38.3% | 44.1% | 37.2% | 39.2% |
| 12Mos | 12.0% | 12.2% | 10.0% | 11.9% | 12.4% | 12.2% | 10.1% | 9.0% | 10.7% | 9.2% | 8.3% | 10.0% | 11.8% | 12.6% |
| 9Mos | 12.1% | 11.3% | 10.4% | 12.5% | 12.0% | 9.0% | 11.2% | 10.6% | 7.9% | 9.1% | 11.5% | 11.5% | 9.5% | 12.6% |
| 6Mos | 9.1% | 9.4% | 7.5% | 7.5% | 8.0% | 8.3% | 7.3% | 7.7% | 7.9% | 9.2% | 8.2% | 8.0% | 10.4% | 7.9% |
| 3Mos | 6.9% | 7.3% | 6.7% | 7.6% | 8.7% | 10.5% | 9.3% | 8.9% | 7.9% | 6.9% | 6.6% | 7.1% | 7.5% | 7.1% |

Injured workers often undergo multiple spinal fusions, either to address ongoing conditions, complications from the earlier surgery, or other spinal problems associated with the work injury. Exhibit 16 shows the percentage of AY 2000 – AY 2012 spinal fusion claims that involved multiple spinal fusions, without respect to the timing of multiple surgical events. The results show that the proportion of spinal fusion claims that involved multiple spinal fusion surgeries ranged from a high of 40 percent in AY 2000 to a low of 14 percent in AY 2012, though once again, the younger claims in this exhibit did not have the same lengthy development periods, so the downward trend seen in the chart during the more recent accident years may be an artifact of shorter development time.

### Exhibit 16: Distribution of Spinal Fusion Claims by Number of Fusion Surgeries

### AY 2000 - AY 2012 Claims

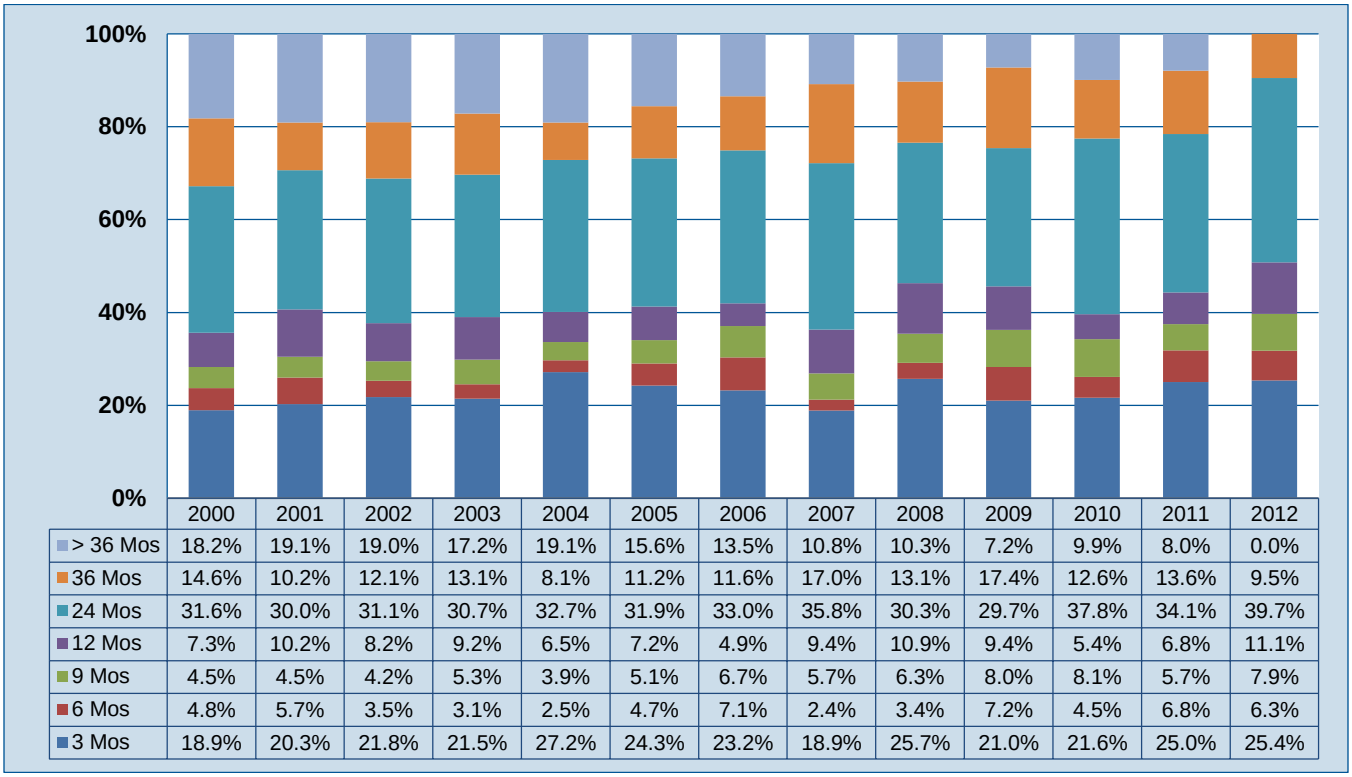



| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3+ | 13% | 12% | 10% | 10% | 7% | 6% | 6% | 4% | 5% | 5% | 3% | 2% | 2% |
| 2 | 27% | 27% | 28% | 28% | 25% | 21% | 22% | 19% | 18% | 17% | 15% | 13% | 12% |
| 1 | 60% | 61% | 62% | 62% | 68% | 73% | 72% | 77% | 77% | 78% | 81% | 86% | 86% |

To determine when second surgeries take place, in addition to calculating the time period between the injury date and first fusion, the author calculated the time period between the first spinal fusion and the second spinal fusion procedure, adjusting for staged procedures that occur on different dates. As with the time period for the initial surgery the timing of second surgeries showed similar patterns for the first 12- and 24-month time periods, for AY 2000 through AY 2012 (Exhibit 17). The results begin to show greater variability for newer claims where the claims are still developing.

### Exhibit 17: Proportion of Claims with 2nd Fusion Procedure - Time Interval Between 1st & 2nd Surgery

### AY 2000 – AY 2012 Claims

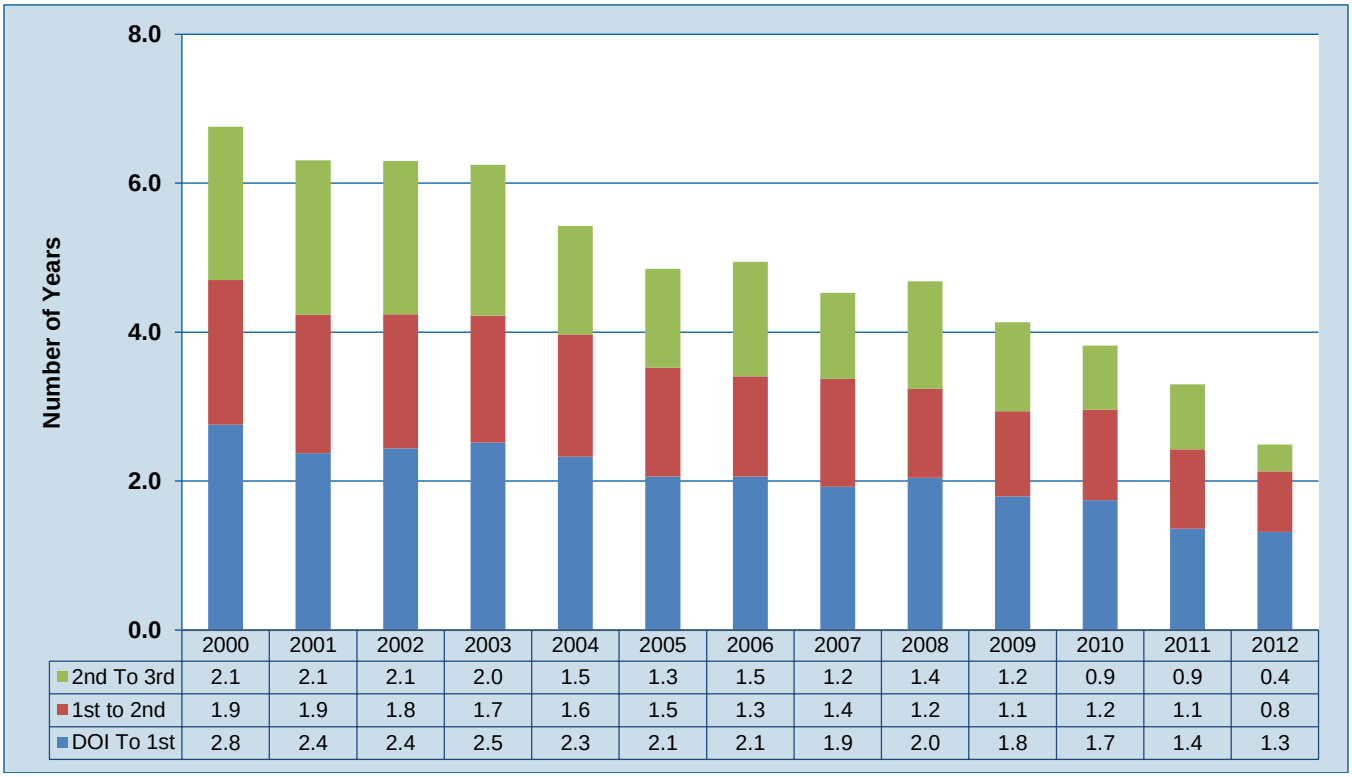



| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| > 36 Mos | 18.2% | 19.1% | 19.0% | 17.2% | 19.1% | 15.6% | 13.5% | 10.8% | 10.3% | 7.2% | 9.9% | 8.0% | 0.0% |
| 36 Mos | 14.6% | 10.2% | 12.1% | 13.1% | 8.1% | 11.2% | 11.6% | 17.0% | 13.1% | 17.4% | 12.6% | 13.6% | 9.5% |
| 24 Mos | 31.6% | 30.0% | 31.1% | 30.7% | 32.7% | 31.9% | 33.0% | 35.8% | 30.3% | 29.7% | 37.8% | 34.1% | 39.7% |
| 12 Mos | 7.3% | 10.2% | 8.2% | 9.2% | 6.5% | 7.2% | 4.9% | 9.4% | 10.9% | 9.4% | 5.4% | 6.8% | 11.1% |
| 9 Mos | 4.5% | 4.5% | 4.2% | 5.3% | 3.9% | 5.1% | 6.7% | 5.7% | 6.3% | 8.0% | 8.1% | 5.7% | 7.9% |
| 6 Mos | 4.8% | 5.7% | 3.5% | 3.1% | 2.5% | 4.7% | 7.1% | 2.4% | 3.4% | 7.2% | 4.5% | 6.8% | 6.3% |
| 3 Mos | 18.9% | 20.3% | 21.8% | 21.5% | 27.2% | 24.3% | 23.2% | 18.9% | 25.7% | 21.0% | 21.6% | 25.0% | 25.4% |

Although the claim sample used for the study included claims with up to 10 separate spinal fusion procedures, this analysis focused on the elapsed time between the date of injury to the first procedure, from the first to the second procedure, and in those claims where the injured worker underwent a third spinal fusion, the elapsed time between the second and third procedure. In analyzing the frequency and timing of multiple spinal fusion procedures over time, the author limited the number of procedures to three and the accident year population to 2000 through 2012. Exhibit 18 shows that the average amount of time to first and to subsequent fusions steadily decreased over time. This decline is in part an artifact of fewer claims with dates out into the future appearing in the dataset of claims with newer dates of injury, so as these more recent claims age, the averages for these accident years will increase.

### Exhibit 18: Average Number of Years From DOI to 1st Fusion, From 1st to 2nd and From 2nd to 3rd by Accident Year

### AY 2000 – AY 2012 Claims




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2nd To 3rd | 2.1 | 2.1 | 2.1 | 2.0 | 1.5 | 1.3 | 1.5 | 1.2 | 1.4 | 1.2 | 0.9 | 0.9 | 0.4 |
| 1st to 2nd | 1.9 | 1.9 | 1.8 | 1.7 | 1.6 | 1.5 | 1.3 | 1.4 | 1.2 | 1.1 | 1.2 | 1.1 | 0.8 |
| DOI To 1st | 2.8 | 2.4 | 2.4 | 2.5 | 2.3 | 2.1 | 2.1 | 1.9 | 2.0 | 1.8 | 1.7 | 1.4 | 1.3 |

**Disputes Over Spinal Fusion Requests**

Utilization review (UR) determines whether a requested service is medically necessary based on evidence-based treatment guidelines and rules adopted by the California Division of Workers' Compensation. Requests for surgery are subject to UR, and if denied by the UR physician may be appealed to Independent Medical Review (IMR). The California Department of Industrial Relations has contracted with Maximus Federal Services, Inc. to provide IMR services to California injured workers who wish to dispute a UR determination to modify or deny a requested treatment.

While the detailed medical payment data from the IRIS database allows for analysis of the frequency of spinal fusion surgeries over time, it does not enable any analysis of fusion procedures that were not performed. To gain a better understanding of the number of requests for spinal fusions that go through the IMR dispute resolution process, the author reviewed the IMR decision letters from 2014 to 2016 and tallied the number of letters that dealt with requests for spinal fusion surgeries, as well as the number of decisions that either overturned or upheld the UR physician's determination that the fusion was not supported by the medical evidence. Exhibit 19 shows that of the 4,852 IMR determination letters related to spinal fusion requests during that 3-year span, 4,520 (93.2 percent), the UR physician's decision to modify or deny the fusion was upheld following the independent medical review.

The IMR data suggests that without the UR and IMR processes, there may have been an additional 4,520 spinal fusion procedures performed during the most recent three years.

### Exhibit 19: Number of IMR Decision Letters for Spinal Fusion Requests and Uphold Rates 2014-2016 IMR Determinations

| Letter Year | Overturned | Upheld | Grand Total |
|---|---|---|---|
| **2014** | 100 (5.7%) | 1,658 (94.3%) | 1,758 |
| **2015** | 127 (7.7%) | 1,531 (92.3%) | 1,658 |
| **2016** | 105 (7.3%) | 1,331 (92.7%) | 1,436 |
| **Grand Total** | **332** | **4,520** | **4,852** |

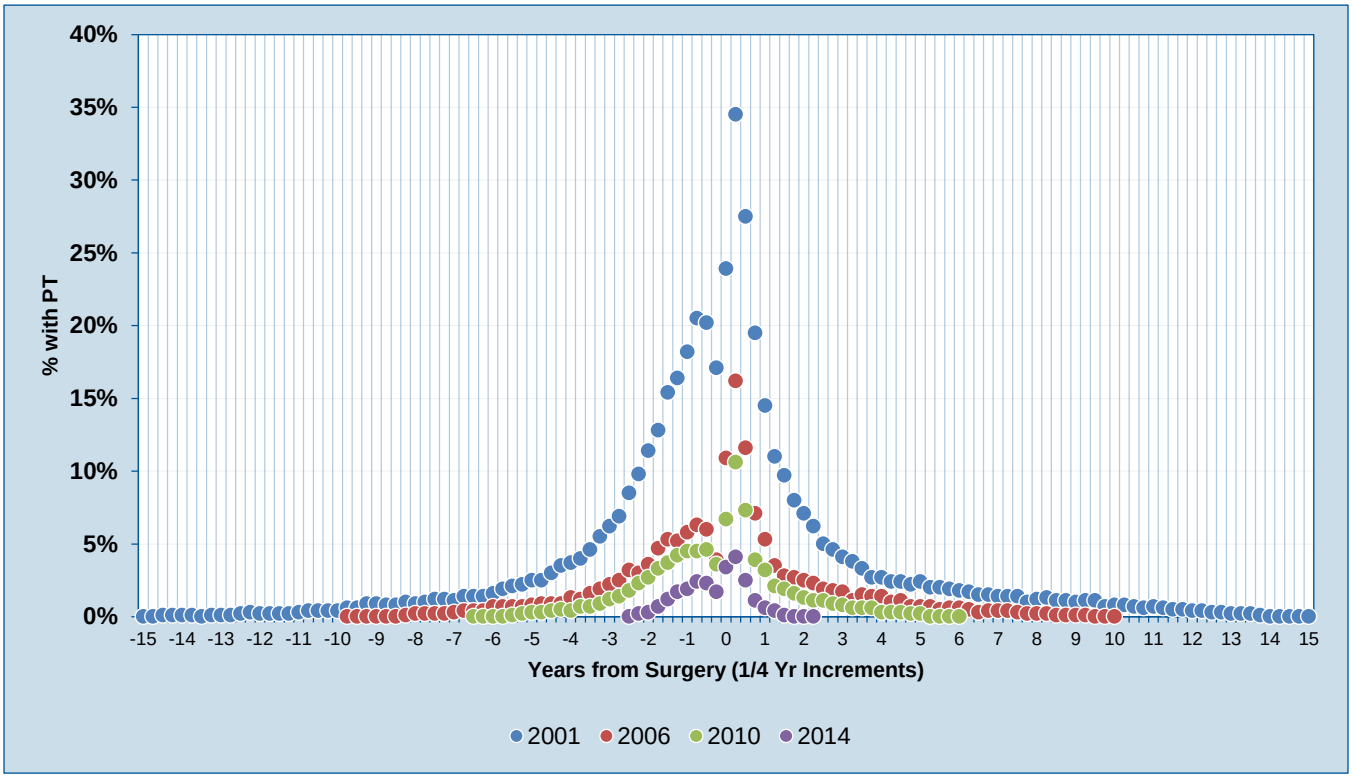
**Associated Services**

Spinal fusion claims typically involve a number of associated services both before and after the surgery. Among the highest volume medical services that are typically found in spinal fusion claims are physical therapy, magnetic resonance imaging (MRI), and prescription drugs.

The IRIS database includes detailed medical data on each claim, so the author was able to examine and measure the utilization of these three types of medical services on spinal fusion claims and determine changes in treatment patterns for these services over time.

The frequency and timing of physical therapy visits were calculated for each spinal fusion claim as they related to the first spinal fusion surgery. Exhibit 20 provides a graphic representation of physical therapy services for AY 2001, AY 2006, AY 2010 and AY 2014 spinal fusion claims and reveals a similar pattern for services prior to and post-surgery for each of the accident years. The most striking difference in the frequency pattern was in the AY 2001 claims, which involved significantly higher utilization of physical therapy services. The impact of the 24-visit cap that was implemented for injuries with a date of injury on or after January 1, 2004, included as part of the 2003 reforms (SB 228), is clearly seen in the claims for accident years 2006, 2010 and 2014.

### Exhibit 20: Utilization of Pre- and Post-Surgery Physical Therapy Services AY 2001, 2006, 2010 and 2014 Spinal Fusion Claims



The use of Magnetic Resonance Imaging (MRI) studies to assist in the diagnosis and treatment decisions for spinal disorders was consistent across the AY 2000 – AY 2014 spinal fusion claim populations. The median number of scans performed per claim was three for AY 2000 through 2012. As is the case with multiple surgical procedures, the number of MRI studies per claim increase over time as claims age. Exhibit 21 shows the average and median number of MRI studies for each accident year, as well as the maximum number of studies associated with any single claim. The data on the maximum number of MRI studies in each accident year clearly shows that there are instances where a significant number of studies appear in the data for any single individual who has undergone spinal fusion surgery, with the highest number of MRI scans for one injured worker being 49, recorded for an AY 2008 spinal fusion claim.

### Exhibit 21: Number of MRI Studies Per Fusion Claim by Accident Year

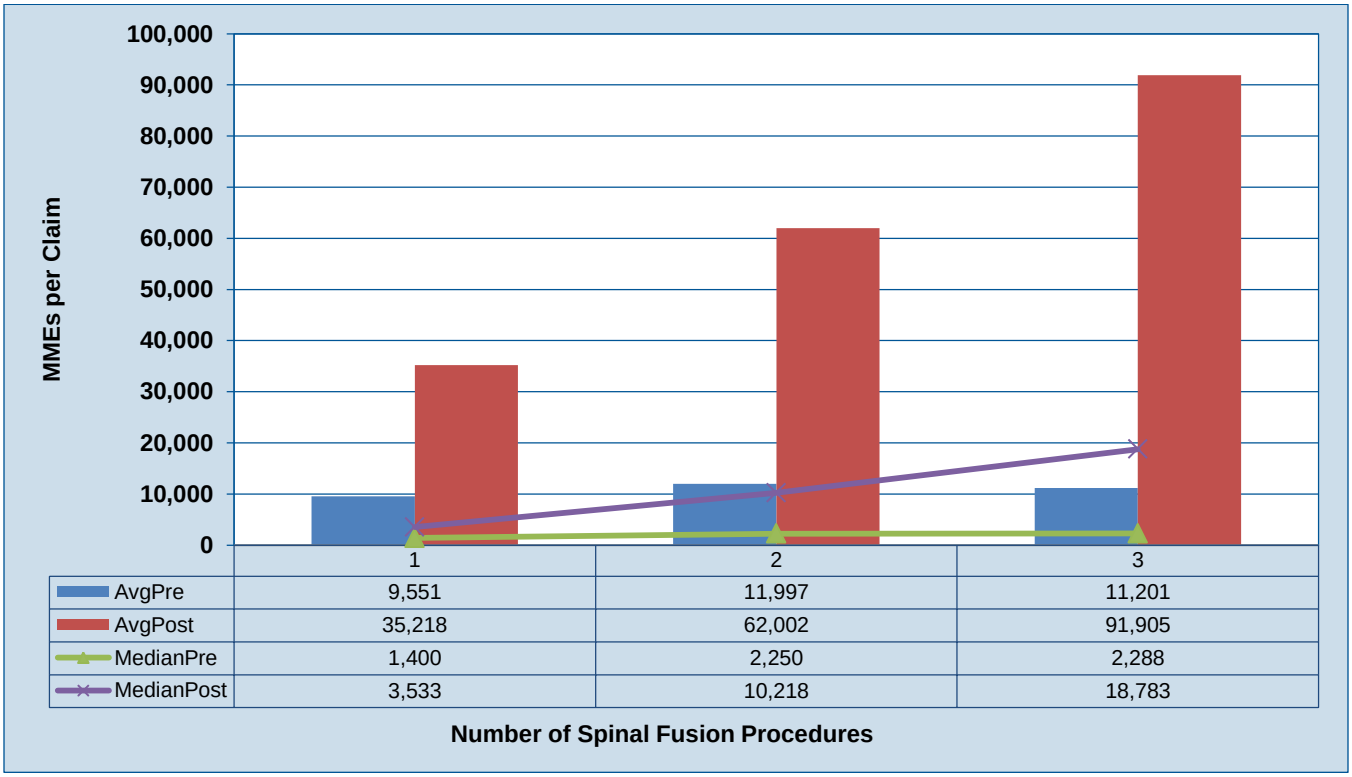
### AY 2000 – AY 2014 Claims

| AY | Average | Median | Max |
|---|---|---|---|
| **2000** | 4.3 | 3 | 41 |
| **2001** | 4.2 | 3 | 42 |
| **2002** | 4.3 | 3 | 25 |
| **2003** | 4.2 | 3 | 25 |
| **2004** | 4.1 | 3 | 33 |
| **2005** | 3.8 | 3 | 26 |
| **2006** | 4.0 | 3 | 25 |
| **2007** | 4.0 | 3 | 23 |
| **2008** | 3.8 | 3 | 49 |
| **2009** | 4.1 | 3 | 23 |
| **2010** | 3.7 | 3 | 19 |
| **2011** | 3.5 | 3 | 17 |
| **2012** | 3.2 | 3 | 17 |
| **2013** | 2.8 | 2 | 14 |
| **2014** | 2.6 | 2 | 14 |
| **2000 - 2014** | **4.0** | **3** | **49** |

The author measured the amounts of medication dispensed to the injured worker before and after their spinal fusion as a proxy for the success of the treatment. The working assumption was that if the spinal fusion was successful, opioid medications in particular would decline after surgery. National Drug Codes and associated dispensing dates were extracted from the IRIS database and augmented with descriptive information from a Medi-Span[12] database of all pharmaceutical drugs. The descriptive information included the drug's therapeutic group and class description, active ingredient, strength, route of administration, and other characteristics. The descriptive information was used to convert opioid medications into standard Morphine Milligram Equivalents (MMEs) to facilitate the comparative analysis across the population and over time.

The cumulative MMEs per claim were calculated based on dispensing dates prior to the first spinal fusion surgery on a claim and more than 30 days after the last surgery on claims with one fusion procedure; claims with two fusion procedures; and claims with three fusion procedures. Exhibit 22 shows the average and the median number of MMEs dispensed to injured workers within each of the three subpopulations. In all three groups, the average number of MMEs dispensed to the injured workers was significantly higher than the median values. Whether looking at the average or the median values for each claim subset, the amount of opiates dispensed beyond 30 days after the fusion surgery were much higher than the amounts dispensed prior to surgery. This suggests that pain levels increased after surgery. In addition, the high median values for post-surgical MMEs suggest that opiate usage continued for years following the spinal fusions for each of the three claim subsets (1, 2, or 3 fusions).

### Exhibit 22: Morphine Milligram Equivalents per Claim Pre-Fusion and Greater Than 30 Days Post Last Fusion




| | 1 | 2 | 3 |
|---|---|---|---|
| AvgPre | 9,551 | 11,997 | 11,201 |
| AvgPost | 35,218 | 62,002 | 91,905 |
| MedianPre | 1,400 | 2,250 | 2,288 |
| MedianPost | 3,533 | 10,218 | 18,783 |

12. Master Drug Data Base (MDDB®) Version 2.5 Documentation manual, Wolters Kluwer Health, Medi-Span.

## DISCUSSION

Data analyzed for this study show that the majority of spinal fusion procedures are performed as treatment for lower back disorders. This is not surprising when one considers the prevalence of low back pain in the adult population – ranking as "the most common cause of job-related disability and a leading contributor to missed work days."[13] There has been much research and scholarly discussion related to best treatment options for low back pain,[14,15,16,17] and spinal fusion continues to lack consensus as the most beneficial treatment option in light of some evidence that it causes additional damage and chronic pain.

One of the risks associated with spinal fusion surgery is the mechanical stress that is created on adjacent vertebral segments when fusion occurs.[18,19] Adjacent segment degeneration (ASD), which may lead to subsequent surgical procedures to stabilize the adjacent segment(s), is one reason multiple spinal fusions may occur for the same patient. Other reasons include implanted device complications, failed fusion (pseudarthrosis) or occurrence of a new problem unrelated to the initial fusion surgery.[20]

In their 2015 study Anderson, et al[21] referenced "reoperation rates of 22% to 27% after fusion" reported in studies from workers' compensation jurisdictions. This reoperation range corresponds to the California workers' compensation data analyzed in this study. Exhibit 16 showed that 40 percent of injured workers with AY 2000 claims who received a spinal fusion underwent multiple spinal fusion procedures, while data on more recent claims show that among spinal fusion claims from AY 2012, 14 percent had already involved multiple fusions at three years post injury. Furthermore, in many of those claims, there is a strong likelihood that additional fusions will be performed in the future given that historically the average time period between surgeries is one to two years, with variation within that average increasing as more spinal fusions are performed.

Within the claim sample used in this study the maximum number of spinal fusion codes associated with a single claim was 10, and these procedures were performed over the course of 6.3 years. Acknowledging that this case is one of the outliers, it does beg the question of what could cause an individual to undergo 10 surgical procedures related to spinal fusion. In this case the initial injury was to the leg – described by ICD-9 codes for initial and early treatment. The first spinal fusion, which was performed six months after the injury, was for "Displacement of cervical intervertebral disc without myelopathy."[22] This was followed ten months later by a lumbar spinal

13. National Institute of Neurological Disorders and Stroke (NIH). *Low Back Pain Fact Sheet*. https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Low-Back-Pain-Fact-Sheet
14. *Ibid*
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fusion for "spinal stenosis, lumbar region without neurogenic claudication."[23] Six reoperations followed for the lumbar spine, with diagnoses indicating implantable device complications and "postlaminectomy syndrome, lumbar region"[24] (aka "failed back syndrome"). The tenth spinal fusion was performed to treat lumbar disc degeneration, five years after the first lumbar fusion.

The case just described may be considered an extreme example of what can go wrong, but it also serves as an example of the importance of evidence-based medicine and the UR and IMR process that is now in place for California workers' compensation.[25] It is not possible to ascertain from the data alone whether or not lumbar spinal fusion was supported in the absence of neurogenic claudication – "the tendency of exacerbation of symptoms due to walking, standing, and maintaining certain postures"[26] - but it may well have fallen into the category of the 90+ percent uphold rates for IMR appeals (based purely on the diagnosis codes submitted by the physician).

A review of 15 randomly selected IMR decision letters with overturn determinations showed that seven of the requests were for fusion procedures to address instability caused by previous fusion - spinal hardware issues generating pain and adjacent segment instability. The remaining eight overturn decisions were for spinal fusion procedures without history of a previous fusion.

Underlying the medical necessity determinations for spinal fusion surgery are clinical history descriptions and MRI findings. As shown in Exhibit 21, multiple MRIs were performed for the study population, with an average of four per claim and a median of three. The range for the maximum number of MRIs per claim was an astounding 14 scans for newer (AY 2014) claims to 49 scans for older (AY 2008) claims. Deyo, et al (2009) discussed the positive correlation between high rates of spine imaging rates and high surgery rates across geographic regions,[27] and cited studies showing that positive MRI studies are common in asymptomatic people, noting that "one-third to two-thirds of spinal computed tomography imaging and MRI may be inappropriate."[28]

Continued use of opioids after surgical intervention is cause for concern, especially in light of the findings from this study indicating that that opioid use increases after spinal fusion surgery and continues for long periods of time. The use of opioids in all forms (oral, injectable, infused, dermal) suggests that the surgical procedures in many cases may have actually generated or increased chronic pain. In many cases the spinal surgery itself may have resulted in substance abuse issues, as reflected in the frequency with which substance abuse appears as a comorbid diagnosis in the fusion claims (Exhibit 11 and Appendix 2).

Substance abuse is one of five comorbid conditions included in the comparative analysis within the spinal fusion claim population, as well as in the comparative analysis of medical back claims with and without spinal fusions. While it is not possible to analyze the interplay between comorbidities on treatment decisions and outcomes, it

23. Ibid
24. Ibid
25. SB 228 gave presumption of correctness to the practice guidelines of the American College of Occupational and Environmental Medicine (ACOEM) effective March 22, 2004. These guidelines were newly in effect at the time of the initial lumbar fusion and under the guidelines spinal fusion was questionable.
26. Levin, K.H. Low Back Pain, Definition, Chronic Lumbar Radiculopathy. Cleveland Clinic Center for Continuing Education. August 2010. http://www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/neurology/low-back-pain/
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was possible to measure the impact on costs. Depending on the accident year, the presence of comorbid conditions in spinal fusion claims was associated with both higher medical payments (40.8 percent to 94.8 percent higher) and higher indemnity payments (24.8 percent to 81.2 percent higher).

Spinal fusion is a valid and important treatment option to resolve medical conditions that are discreetly identified and unresponsive to other less invasive and less risky procedures. However, the medical data analyzed as part of this study, including the high percentage of IMR decisions upholding UR determinations that are not in agreement with spinal fusion requests, suggests that more discernment is needed to avoid negative consequences for injured workers and financial costs to the system as a whole.

## APPENDICES

### Appendix 1: Spinal Fusion Procedures Involving Implantation of Hardware

| CPT | Description |
|---|---|
| **22551** | Arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophytectomy and decompression of spinal cord and/or nerve roots; cervical below C2 |
| **22552** | Arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophytectomy and decompression of spinal cord and/or nerve roots; cervical below C2, each additional interspace (List separately in addition to code for separate procedure) |
| **22554** | Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); cervical below C2 |
| **22556** | Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); thoracic |
| **22558** | Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); lumbar |
| **22585** | Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); each additional interspace (List separately in addition to code for primary procedure) |
| **22586** | Arthrodesis, pre-sacral interbody technique, including disc space preparation, discectomy, with posterior instrumentation, with image guidance, includes bone graft when performed, L5-S1 interspace |
| **22590** | Arthrodesis, posterior technique, craniocervical (occiput-C2) |
| **22595** | Arthrodesis, posterior technique, atlas-axis (C1-C2) |
| **22600** | Arthrodesis, posterior or posterolateral technique, single level; cervical below C2 segment |
| **22610** | Arthrodesis, posterior or posterolateral technique, single level; thoracic (with lateral transverse technique, when performed) |
| **22612** | Arthrodesis, posterior or posterolateral technique, single level; lumbar (with lateral transverse technique, when performed) |
| **22614** | Arthrodesis, posterior or posterolateral technique, single level; each additional vertebral segment (List separately in addition to code for primary procedure) |
| **22630** | Arthrodesis, posterior interbody technique, including laminectomy and/or discectomy to prepare interspace (other than for decompression), single interspace; lumbar |
| **22632** | Arthrodesis, posterior interbody technique, including laminectomy and/or discectomy to prepare interspace (other than for decompression), single interspace; each additional interspace (List separately in addition to code for primary procedure) |

## Appendix 1: Spinal Fusion Procedures Involving Implantation of Hardware (Continued)

| CPT | Description |
|---|---|
| **22633** | Arthrodesis, combined posterior or posterolateral technique with posterior interbody technique including laminectomy and/or discectomy sufficient to prepare interspace (other than for decompression), single interspace and segment; lumbar |
| **22634** | Arthrodesis, combined posterior or posterolateral technique with posterior interbody technique including laminectomy and/or discectomy sufficient to prepare interspace (other than for decompression), single interspace and segment; each additional interspace and segment (List separately in addition to code for primary procedure) |
| **22840** | Posterior non-segmental instrumentation (eg, Harrington rod technique, pedicle fixation across 1 interspace, atlantoaxial transarticular screw fixation, sublaminar wiring at C1, facet screw fixation) (List separately in addition to code for primary procedure) |
| **22841** | Internal spinal fixation by wiring of spinous processes (List separately in addition to code for primary procedure) |
| **22842** | Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 3 to 6 vertebral segments (List separately in addition to code for primary procedure) |
| **22843** | Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 7 to 12 vertebral segments (List separately in addition to code for primary procedure) |
| **22844** | Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 13 or more vertebral segments (List separately in addition to code for primary procedure) |
| **22845** | Anterior instrumentation; 2 to 3 vertebral segments (List separately in addition to code for primary procedure) |
| **22846** | Anterior instrumentation; 4 to 7 vertebral segments (List separately in addition to code for primary procedure) |
| **22847** | Anterior instrumentation; 8 or more vertebral segments (List separately in addition to code for primary procedure) |
| **22848** | Pelvic fixation (attachment of caudal end of instrumentation to pelvic bony structures) other than sacrum (List separately in addition to code for primary procedure) |
| **22849** | Reinsertion of spinal fixation device |
| **22850** | Removal of posterior nonsegmental instrumentation (eg, Harrington rod) |
| **22852** | Removal of posterior segmental instrumentation |
| **22853** | Insertion of interbody biomechanical device(s) (eg, synthetic cage, mesh) with integral anterior instrumentation for device anchoring (eg, screws, flanges), when performed, to intervertebral disc space in conjunction with interbody arthrodesis, each interspace (List separately in addition to code for primary procedure) |
| **22854** | Insertion of intervertebral biomechanical device(s) (eg, synthetic cage, mesh) with integral anterior instrumentation for device anchoring (eg, screws, flanges), when performed, to vertebral corpectomy(ies) (vertebral body resection, partial or complete) defect, in conjunction with interbody arthrodesis, each contiguous defect (List separately in addition to code for primary procedure) |
| **22859** | Insertion of intervertebral biomechanical device(s) (eg, synthetic cage, mesh, methylmethacrylate) to intervertebral disc space or vertebral body defect without interbody arthrodesis, each contiguous defect (List separately in addition to code for primary procedure) |
| **22855** | Removal of anterior instrumentation |

## Appendix 2: Comorbidity Data for Medical Back Claims
## Number of Comorbidities per Claim as Percent of Total Fusion Medical Back Claims

### AY 2000 – AY 2014 Claims

| AY | Cnt = 0 | Cnt = 1 | Cnt = 2 | Cnt = 3 | Cnt = 4 | Cnt = 5 |
|---|---|---|---|---|---|---|
| **2000** | 46.61% | 26.89% | 18.67% | 5.87% | 1.83% | 0.13% |
| **2001** | 41.67% | 29.78% | 18.42% | 7.37% | 2.23% | 0.54% |
| **2002** | 38.37% | 29.94% | 20.80% | 7.80% | 2.53% | 0.56% |
| **2003** | 32.92% | 31.60% | 21.81% | 9.96% | 3.29% | 0.41% |
| **2004** | 30.50% | 34.16% | 21.88% | 9.80% | 3.27% | 0.40% |
| **2005** | 29.61% | 33.96% | 25.25% | 8.85% | 1.89% | 0.44% |
| **2006** | 30.44% | 35.19% | 22.42% | 8.84% | 2.95% | 0.16% |
| **2007** | 32.86% | 30.92% | 24.20% | 8.48% | 3.36% | 0.18% |
| **2008** | 32.74% | 30.56% | 23.21% | 10.32% | 2.38% | 0.79% |
| **2009** | 35.28% | 32.48% | 21.26% | 9.11% | 1.64% | 0.23% |
| **2010** | 40.86% | 31.45% | 16.94% | 9.41% | 1.08% | 0.27% |
| **2011** | 50.00% | 29.04% | 16.17% | 3.59% | 0.90% | 0.30% |
| **2012** | 59.51% | 29.55% | 8.50% | 2.43% | 0.00% | 0.00% |
| **2013** | 80.23% | 12.99% | 4.52% | 2.26% | 0.00% | 0.00% |
| **2014** | 96.53% | 2.78% | 0.69% | 0.00% | 0.00% | 0.00% |
| **Combined Average** | **38.75%** | **30.44%** | **20.10%** | **8.00%** | **2.33%** | **0.38%** |

## Number of Comorbidities per Claim as Percent of Total Non-Fusion Medical Back Claims

### AY 2000 – AY 2014 Claims

| AY | Cnt = 0 | Cnt = 1 | Cnt = 2 | Cnt = 3 | Cnt = 4 | Cnt = 5 |
|---|---|---|---|---|---|---|
| **2000** | 91.0% | 6.6% | 1.7% | 0.5% | 0.1% | 0.0% |
| **2001** | 91.0% | 6.7% | 1.6% | 0.5% | 0.1% | 0.0% |
| **2002** | 89.8% | 7.6% | 1.9% | 0.5% | 0.1% | 0.0% |
| **2003** | 88.2% | 9.0% | 2.1% | 0.6% | 0.2% | 0.0% |
| **2004** | 87.8% | 9.4% | 2.1% | 0.5% | 0.1% | 0.0% |
| **2005** | 85.9% | 11.0% | 2.4% | 0.5% | 0.1% | 0.0% |
| **2006** | 83.5% | 12.6% | 3.2% | 0.6% | 0.1% | 0.0% |
| **2007** | 82.0% | 13.7% | 3.3% | 0.8% | 0.2% | 0.0% |
| **2008** | 78.7% | 16.3% | 4.0% | 0.9% | 0.2% | 0.0% |
| **2009** | 76.6% | 17.5% | 4.6% | 1.1% | 0.3% | 0.0% |
| **2010** | 76.3% | 18.4% | 4.2% | 1.0% | 0.2% | 0.0% |
| **2011** | 79.1% | 16.4% | 3.7% | 0.8% | 0.1% | 0.0% |
| **2012** | 81.5% | 14.7% | 3.1% | 0.6% | 0.1% | 0.0% |
| **2013** | 88.6% | 9.8% | 1.4% | 0.2% | 0.0% | 0.0% |
| **2014** | 95.6% | 3.8% | 0.5% | 0.1% | 0.0% | 0.0% |
| **Combined Average** | **86.0%** | **10.7%** | **2.5%** | **0.6%** | **0.1%** | **0.0%** |

## Percent of Fusion Claims w/ Comorbid Condition (Diagnostic Category Medical Back)

## AY 2000 – AY 2014 Claims

| AY | Metabolic & Endocrine Disorders | Circulatory System | Mental Disorders | Substance Abuse | Obesity |
|---|---|---|---|---|---|
| **2000** | 12.3% | 27.0% | 32.1% | 14.9% | 3.5% |
| **2001** | 12.2% | 29.3% | 33.9% | 16.6% | 8.3% |
| **2002** | 13.1% | 30.1% | 36.5% | 20.1% | 8.0% |
| **2003** | 16.2% | 34.9% | 38.8% | 22.2% | 8.2% |
| **2004** | 14.5% | 35.0% | 41.4% | 21.4% | 10.2% |
| **2005** | 13.5% | 31.2% | 41.4% | 24.2% | 10.4% |
| **2006** | 13.6% | 32.6% | 46.8% | 16.7% | 9.5% |
| **2007** | 14.5% | 32.5% | 44.0% | 15.0% | 13.1% |
| **2008** | 17.7% | 30.8% | 44.4% | 15.7% | 12.9% |
| **2009** | 13.8% | 32.9% | 41.4% | 9.8% | 12.1% |
| **2010** | 13.2% | 25.3% | 37.9% | 11.6% | 11.3% |
| **2011** | 8.7% | 24.3% | 27.2% | 9.6% | 7.5% |
| **2012** | 10.1% | 16.6% | 15.0% | 6.9% | 5.3% |
| **2013** | 6.2% | 9.0% | 6.2% | 2.8% | 4.5% |
| **2014** | 0.0% | 2.1% | 0.7% | 0.0% | 1.4% |
| **Combined Average** | **13.3%** | **29.9%** | **36.8%** | **17.1%** | **8.8%** |

## Percent of Non-Fusion Claims w/ Comorbid Condition (Diagnostic Category Medical Back)

## AY 2000 – AY 2014 Claims

| AY | Metabolic & Endocrine Disorders | Circulatory System | Mental Disorders | Substance Abuse | Obesity |
|---|---|---|---|---|---|
| **2000** | 1.7% | 2.7% | 5.6% | 1.2% | 0.9% |
| **2001** | 1.5% | 2.5% | 5.9% | 1.3% | 0.8% |
| **2002** | 1.6% | 3.2% | 6.5% | 1.3% | 0.9% |
| **2003** | 1.9% | 3.8% | 7.2% | 1.6% | 1.1% |
| **2004** | 1.8% | 3.5% | 7.4% | 2.0% | 1.1% |
| **2005** | 1.9% | 3.6% | 8.7% | 2.7% | 1.2% |
| **2006** | 2.2% | 4.0% | 11.0% | 3.0% | 1.3% |
| **2007** | 2.4% | 4.6% | 12.9% | 2.3% | 1.3% |
| **2008** | 2.8% | 5.1% | 16.0% | 2.5% | 1.3% |
| **2009** | 3.1% | 5.3% | 18.1% | 2.6% | 1.9% |
| **2010** | 3.0% | 5.8% | 17.3% | 2.2% | 2.1% |
| **2011** | 2.4% | 5.1% | 15.0% | 2.3% | 1.6% |
| **2012** | 2.2% | 4.8% | 12.0% | 2.2% | 1.8% |
| **2013** | 1.3% | 3.2% | 6.7% | 1.1% | 1.0% |
| **2014** | 0.8% | 1.4% | 2.0% | 0.3% | 0.5% |
| **Combined Average** | **2.0%** | **3.8%** | **9.4%** | **1.9%** | **1.2%** |

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CWCI Reports to the Industry are published by the California Workers' Compensation Institute.

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## Acknowledgments

The author would like to thank the following CWCI staff members for their input and contributions in the drafting and preparation of this report:

- Brenda Ramirez, Claims and Medical Director
- Rena David, Senior Vice-President, Research and Operations
- Steve Hayes, Senior Research Associate
- Bob Young, Communications Director

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