

# Lumbar Discectomy and Reoperation Among Workers' Compensation Cases in Florida and New York

## *Are Treatment Trends Similar to Other Payer Types?*

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**Objective:** The aim of this study was to better understand current treatment trends and revision rates for lumbar disc herniation (LDH) in the workers' compensation (WC) population compared with other payer types.

**Methods:** This was a retrospective analysis of outpatient claims data from Florida and New York during 2014 to 2016. **Results:** WC patients were less likely to undergo discectomy in Florida (15% vs 19%;  $P < 0.001$ ) and New York (10% vs 15%;  $P < 0.001$ ). The odds of WC patients undergoing revision discectomy were 1.5 times greater than patients covered by private payers or all other non-WC payers ( $P = 0.002$ ). **Conclusions:** WC patients undergo discectomy significantly less often than non-WC counterparts, which may be related to a higher risk of reoperation. New evidence-based treatments, such as annular repair, may be critical to advancing care in this unique population.

**Keywords:** annular repair, disc herniation, discectomy, lumbar, revision surgery, treatment policies, workers' compensation

Workers' compensation (WC) programs insure employees against the risks of lost wages and medical costs associated with job-related injury or illness. In the United States, these WC programs vary from state-to-state and insure over 140 million jobs.<sup>1</sup> Employers pay nearly \$100 billion per year in premiums and benefits, including \$31.2 billion in medical benefits and \$30.8 billion for lost wages.<sup>1</sup> Among WC claims, lumbar disc herniation (LDH) has incurred the highest 18-month total costs compared with any other diagnosis and has one of the highest indemnity severities.<sup>2,3</sup> This may be related to the high frequency of permanent partial injury (50% to 100%)<sup>4</sup> and the current treatment challenges for LDH. The number of treatments that a patient receives for LDH is highly correlated ( $r = 0.90$ ) with the duration of lost-time claims, which are associated with prolonged return-to-work and greater costs.<sup>2</sup> Given the high indemnity severity and the tight correlation with repeat treatments, the current therapies or policies may not be optimal for helping WC patients with symptomatic LDH return to work.

From the Department of Surgery (Dr Ammerman, Dr Wind); Department of Neurological Surgery, George Washington University Hospital (Dr Wind); Department of Orthopedic Surgery (Dr Goldsmith), Sibley Memorial Hospital, Washington DC; and Telos Partners, LLC, Denver, Colorado (Dr Inzana). Clinical significance: Workers' compensation (WC) patients undergo discectomy significantly less often than non-WC counterparts, despite the superiority of discectomy over nonsurgical care. This may be related to a higher risk of reoperation in WC patients. New evidence-based treatments, such as annular repair, may be critical to advancing care in this population.

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Nonsurgical treatments for LDH with radiculopathy include corticosteroid injections, analgesics, physical therapy, or manual spinal manipulation.<sup>5,6</sup> However, many patients do not improve with continuing nonsurgical care and ultimately require surgery for persistent symptoms, as evidenced by up to 54% of patients crossing over to discectomy in randomized controlled trials.<sup>7–10</sup> For indicated patients, discectomy is superior to continuing nonsurgical care in achieving faster improvement in pain and function, in minimizing productivity loss and in addressing neurological deficits.<sup>7–11</sup>

Some studies have suggested that discectomy is less successful in the WC population, but the etiology of such findings remains unclear.<sup>12,13</sup> The WC population is comprised of patients with different characteristics, such as younger age, a higher frequency of men and smokers, different ethnic and educational backgrounds, and worse baseline disability and quality of life scores compared with non-WC groups.<sup>12–14</sup> Many of these characteristics, such as younger age, male sex, smoking, and occupational lifting, are risk factors for recurrent herniation and reoperation.<sup>15–18</sup> Similarly, Martin et al<sup>19</sup> reported significantly higher reoperation rates among WC versus private pay or government programs.

A higher risk of reoperation may influence healthcare providers or policy makers to delay, avoid, or limit access to discectomy in the WC population. Nonsurgical care may not adequately or sustainably address patient symptoms. It is critical to better understand the current treatment trends for LDH and to implement more effective techniques for successful recovery and return-to-work in the WC population. The aim of this study was to examine the patient characteristics, surgery rates for LDH-related diagnoses, and revision surgery rates for discectomy in the WC population in contrast to other major payer types in two large WC states: New York and Florida.

## METHODS

### Study Design and Data Source

This study was a retrospective analysis of outpatient healthcare records from Florida and New York. The reporting of this study followed the recommendations described by the Reporting of Studies Conducted using Observational Routinely-collected Health Data (RECORD) statement.<sup>20</sup> Outpatient encounter data from Florida and New York were collected from State Ambulatory Surgery and Services Databases (SASD) from the Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ). New York and Florida are the 3rd and 4th largest states in terms of WC-covered jobs as of 2017.<sup>1</sup> The largest and second largest states, California and Texas, did not have outpatient data available through HCUP. Data were evaluated from the latest available 3-year period (2014 to 2016) to understand recent trends and provide an adequate multi-year sample for each state. Not all facilities submit data to HCUP, so the volumes are an underrepresentation of the total volumes each year in each state. Therefore, the analyses in this study focused on proportions.

### Patient Populations and Variables

This study evaluated adult patients 21 to 75 years of age with an outpatient encounter at HCUP-participating facilities in Florida or New York between January 1, 2014 and December 31, 2016.

**TABLE 1.** Variables and Criteria Used to Identify and Sort the Analysis Populations

Category	Criteria	Description
Age	21–75 yrs	Age range for all analyses
Discectomy codes	CPT codes: 63030 (primary) or 63042 (revision)	Primary and revision discectomy populations
LDH-related diagnosis codes	ICD-10 codes (2016 only): M5126, M5127, M5116, M5117, M5416, M5417	Disc displacement, disc disorders w/ radiculopathy, or radiculopathy; lumbar or lumbosacral
HCUP payer codes	PAY1 = 1 (Medicare) PAY1 = 2 (Medicaid) PAY1 = 3 (Private) PAY1_X = <state-specific> (WC)	Stratification by payer type
Surgical procedures	HCUP Narrow Surgery Code $\geq$ 1	Encounters with at least one surgical procedure (characterized by HCUP)
Revision discectomy	Two encounters with overlapping revisit codes, with CPT 63030 preceding CPT 63042	Patients who had a primary discectomy (63030) and later a revision (63042)
Lumbar fusion codes	CPT codes: 22533, 22558, 22612, 22630, 22632, 22633, 22634, 22534, 22585, 22614	Patients with a concurrent fusion code were excluded from discectomy analyses

Considering the SASD contains encounter-level data, unique patients were identified using the HCUP revisit codes (“VisitLink”) within each state. Current Procedural Terminology (CPT) codes and the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes were used to identify procedures and LDH-related diagnoses, respectively, for each encounter (Table 1). Analyses based on LDH-related ICD-10 diagnoses were only performed for 2016 data, since transition from ICD-9 to ICD-10 occurred during 2015. Analyses based on CPT procedure codes included all 2014 to 2016 data. Primary payer codes, as summarized by HCUP, were utilized to stratify patients according to the general payer type for claims (Medicare, Medicaid, Private, WC, or Other). The HCUP Narrow Surgery Code was used to identify patients with an LDH-related diagnosis that underwent at least one surgery, regardless of surgery type. For analyses specifically evaluating discectomy procedures, encounters with a concurrent lumbar fusion CPT code were excluded.

## Outcomes

The primary outcomes included the rate of surgery for LDH-related diagnosis, the rate of discectomy for LDH-related diagnosis, and the rate of revision discectomy. Revision discectomy rates were evaluated on a per-patient basis. Therefore, revision rates represent unique patients with at least one revision discectomy following a primary discectomy, with both occurring during the 2014 to 2016 time period. The time to revision was defined as the time between the first encounter of a primary discectomy CPT code (63030) and the first encounter of a revision discectomy CPT code (63042) occurring after the primary discectomy. Relevant patient characteristics that were evaluable through SASD included age, sex, ethnicity, and rural-urban classification based on the six-category system developed by the National Center for Health Statistics (NCHS). Data on other potential comorbidities or risk factors for reherniation, such as smoking or diabetes, were not available in the SASD.

## Statistical Analysis

Logistic regression was used to evaluate whether revision discectomy rates were different between WC and each of the other payer types (Medicaid, Medicare, Private, Other), while controlling for age, sex, ethnicity, and urban-rural classification. Fisher exact test or Chi-square tests were used to compare the sex, ethnicity, and urban-rural distributions as well as the rates of surgery and revision between patients covered by WC versus non-WC (pooling all other payers). Age and time-to-revision were compared between WC and non-WC using the Mann–Whitney *U* rank test, as these data did not follow a normal distribution based on the D’Agostino & Pearson

test. Logistic regression was performed using R software, v3.6.0 (R Core Team, <https://www.r-project.org/>) and all other analyses were performed in GraphPad Prism v8.3.0 (GraphPad Software; La Jolla, CA).

## RESULTS

### Data Accounting

There were 17,037 unique primary discectomy patients in New York and 24,243 in Florida between 2014 and 2016 (Fig. 1). CPT codes were missing from less than 0.2% of Florida records and 3.3% of New York records. The HCUP VisitLink variable, which acts as a unique patient identifier, was available for 98% of the eligible encounters in New York and 91% of eligible encounters in Florida. Less than 0.01% of the discectomy procedures were excluded for missing payer information.

### Payer Distributions and Patient Characteristics

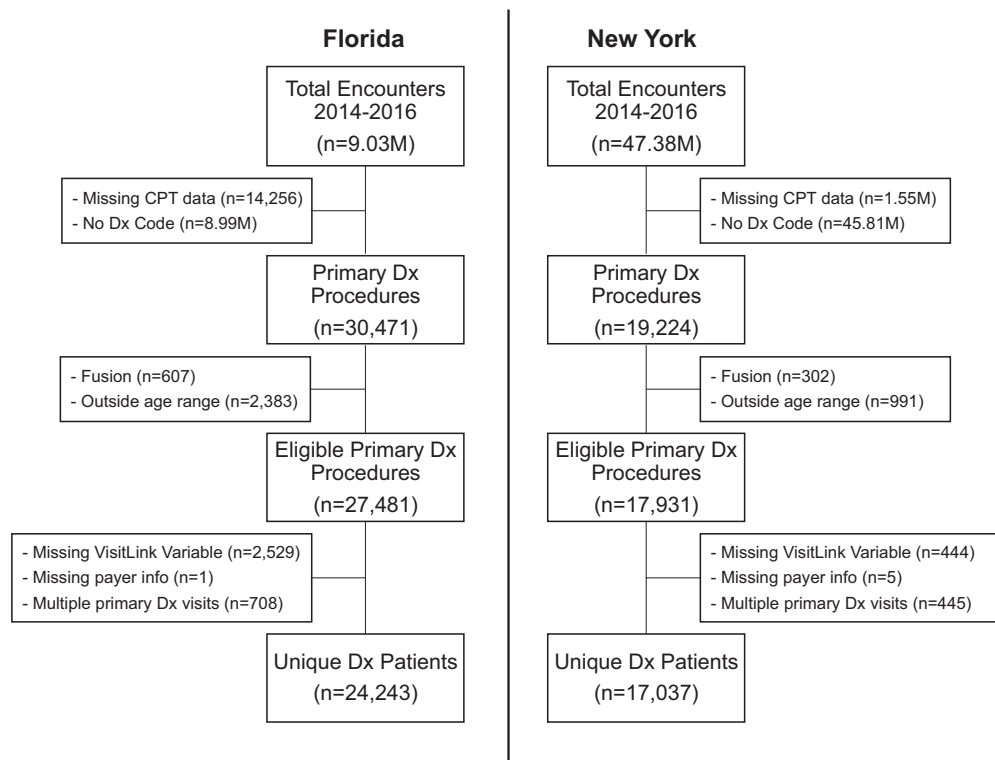
Among all primary discectomy procedures between 2014 and 2016, WC was listed as the primary payer for 8.7% and 10.6% of the encounters in Florida and New York, respectively (pooled = 9.4%). The majority of discectomy procedures were billed to private payers (Fig. 2). The proportion of women and the average age of WC patients receiving primary discectomy were significantly lower than non-WC patients ( $P < 0.001$ ; Tables 2 and 3). Additionally, the distributions of race and urban-rural locations varied significantly between WC and non-WC populations ( $P < 0.001$ ).

### Frequency of Surgical Treatment for LDH

Among patients with an LDH-related diagnosis, WC patients were significantly less likely than non-WC patients to undergo surgery in both Florida (21% vs 27%; odds ratio [OR] = 0.73;  $P < 0.001$ ) and New York (14% vs 18%; OR = 0.74;  $P < 0.001$ ). Discectomy was the most common type of surgery for LDH, regardless of state or payer type (70% to 80% of surgeries). Consequently, the rates of discectomy were also significantly lower for WC versus non-WC patients with an LDH-related diagnosis in both Florida (15% vs 19%; OR = 0.75;  $P < 0.001$ ) and New York (10% vs 15%; OR = 0.66;  $P < 0.001$ ). Among patients with an LDH-related diagnosis, repeat visits occurred after 2.7% of surgery cases and after 36.8% of non-surgical cases (eg, epidural injections) in the WC group, which was similar to other payer types.

### Revision Discectomy Rates

The rate of revision discectomy was significantly greater in the WC population compared with all other payer types in Florida,

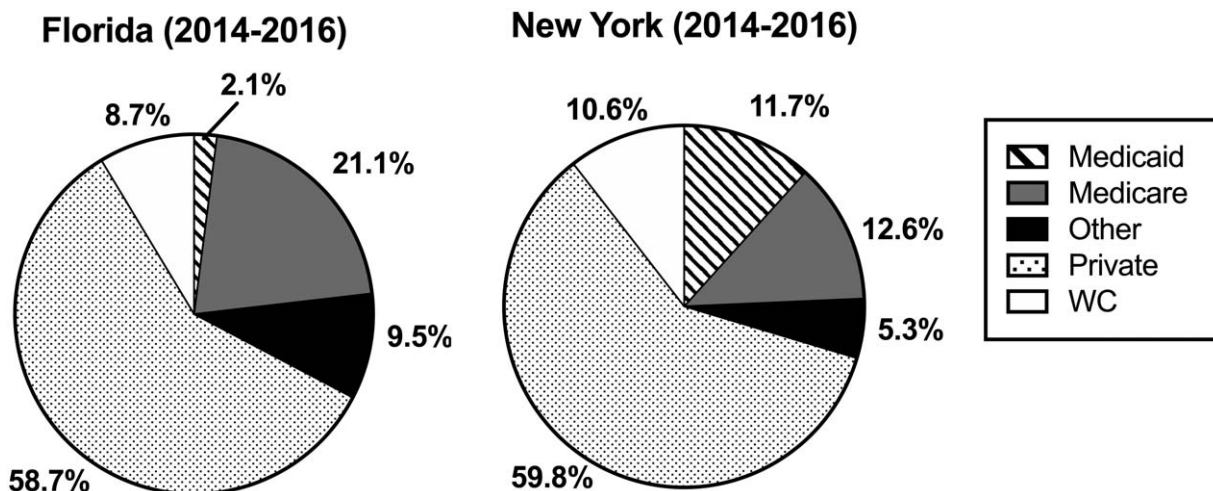


**FIGURE 1.** Flow chart of patient records in Florida and New York to identify eligible discectomy (Dx) procedures and patients for further analysis. Note: VisitLink variable is used as a unique patient identifier.

but the trends were not statistically significant in New York (Table 4). The OR of a patient in Florida experiencing a revision ranged from 0.31 to 0.55 for each payer type relative to WC. These ORs indicate that WC patients were approximately two to three times more likely to undergo revision compared with other payer types in Florida. When pooling the Florida and New York data, the odds of WC patients undergoing revision surgery were 1.5 times greater than their non-WC counterparts (OR = 0.65; reciprocal OR = 1.54). The average time to revision was highly variable and was not significantly different across payers (Table 4).

**DISCUSSION**

The current analysis suggests that WC patients may have an elevated rate of revision discectomy compared with patients in other payer groups (pooled OR = 1.54; *P* = 0.002). However, this finding may vary across states, as the trend was statistically significant in Florida (OR = 2.0; *P* = 0.001) but not in New York (OR = 1.30; *P* = 0.20). Martin et al<sup>19</sup> reported that the revision rate among WC patients in Washington state was 1.5 times greater than other payer types. Additionally, Kukreja et al<sup>21</sup> reported 2-year reoperation rates of 21.7% among WC patients who received discectomy in Louisiana, which is substantially higher than the 2-year national average



**FIGURE 2.** Distributions of payers for primary discectomy procedures in Florida and New York (2014 to 2016).

**TABLE 2.** Primary Discectomy Patient Characteristics Across Payer Types (Florida 2014 to 2016)

Variable	Medicaid (n = 530)	Medicare (n = 5,450)	Other (n = 2,012)	Private (n = 14,662)	Non-WC* (n = 22,654)	WC (n = 1,056)	P-Value WC vs Non-WC
Mean age, yrs	42 ± 10	67 ± 8	45 ± 12	48 ± 12	52 ± 14	45 ± 11	<0.001 <sup>†</sup>
% Female	58%	45%	41%	42%	43%	27%	<0.001 <sup>‡</sup>
Race							
White	63%	88%	65%	82%	82%	68%	
Black	17%	4%	16%	6%	7%	13%	
Hispanic	16%	6%	15%	9%	9%	15%	<0.001 <sup>§</sup>
Asian	0%	0%	1%	1%	1%	0%	
Other	4%	1%	2%	2%	2%	3%	
Rural-urban							
Central Metro	25%	22%	31%	28%	27%	26%	
Fringe Metro	20%	22%	31%	27%	26%	20%	
250k-1M	38%	39%	24%	30%	32%	40%	<0.001 <sup>§</sup>
50k-250k	9%	11%	8%	7%	8%	7%	
Micropolitan	3%	3%	3%	4%	4%	2%	
Rural	5%	3%	2%	4%	3%	4%	

WC, workers' compensation.

\*Non-WC patient population is the pooled result of Medicaid, Medicare, Other, and Private.

<sup>†</sup>Mann-Whitney U test.

<sup>‡</sup>Fisher exact test.

<sup>§</sup>Chi-square test.

of 4%.<sup>22</sup> In contrast, the Spine Patient Outcomes Research Trial (SPORT), which took place across 11 states, did not find significant differences in revision rates between WC and non-WC patients.<sup>15</sup>

While the current study is not able to address the etiology underlying a higher rate of revision in the WC group, it is important to recognize that the characteristics of this group are significantly different. For example, the WC population tends to be comprised of younger individuals, a higher frequency of men and smokers, different ethnic and educational backgrounds, and worse baseline disability and quality of life scores compared with non-WC groups.<sup>12-14</sup> Many of these characteristics, such as a younger age, male sex, smoking, and frequent lifting, have previously been identified as independent risk factors for recurrent herniation.<sup>15-18</sup> The current revision rate analysis controlled for age, sex, ethnicity,

and location, but other covariate data were not available. It is also important to recognize that patients who experience recurrent LDH and reoperation have significantly worse clinical outcomes compared with their counterparts that do not experience recurrence.<sup>15,23,24</sup> Taken together, patients in the WC population may be pre-disposed to a higher risk of recurrence, revision, and worse clinical outcomes, independent of financial benefits associated with an injury claim.

Previous studies that suggested WC patients experience worse outcomes after discectomy<sup>12,13</sup> may have led to a bias against surgery in this population. Consistent with this hypothesis, the current study observed that WC patients with an LDH-related diagnosis underwent discectomy 30% to 50% less often than non-WC patients with the same diagnoses in both Florida and

**TABLE 3.** Primary Discectomy Patient Characteristics Across Payer Types (New York 2014 to 2016)

Variable	Medicaid (n = 1,966)	Medicare (n = 2,171)	Other (n = 864)	Private (n = 10,223)	Non-WC* (n = 15,224)	WC (n = 1,813)	P-Value WC vs Non-WC
Mean age, yrs	43 ± 11	65 ± 10	45 ± 13	46 ± 12	48 ± 13	45 ± 11	<0.001 <sup>†</sup>
% Female	49%	46%	41%	41%	43%	25%	<0.001 <sup>‡</sup>
Race							
White	63%	83%	72%	79%	77%	75%	
Black	10%	4%	6%	4%	5%	8%	
Hispanic	10%	4%	3%	3%	4%	7%	<0.001 <sup>§</sup>
Asian	6%	3%	1%	2%	3%	1%	
Other	11%	7%	18%	11%	11%	10%	
Rural-Urban							
Central Metro	43%	36%	36%	40%	39%	34%	
Fringe Metro	18%	31%	25%	35%	32%	35%	
250k-1M	13%	11%	11%	11%	12%	13%	<0.001 <sup>§</sup>
50k-250k	10%	8%	13%	5%	7%	6%	
Micropolitan	11%	9%	11%	6%	7%	9%	
Rural	5%	4%	4%	3%	3%	4%	

WC, workers' compensation.

\*Non-WC patient population is the pooled result of Medicaid, Medicare, Other, and Private.

<sup>†</sup>Mann-Whitney U test.

<sup>‡</sup>Fisher exact test.

<sup>§</sup>Chi-square test.



**TABLE 4.** Summary of 2014 to 2016 Revision Rates Across Payer Types

Variable	Medicaid	Medicare	Other	Private	Non-WC*	WC	P-Value WC vs Non-WC
Florida							
Revision rate	0.94%	0.99%	0.80%	1.52%	1.32%	2.65%	0.001 <sup>§</sup>
OR Relative to WC (95% CI)	0.36 <sup>†</sup> (0.12–0.86)	0.41 <sup>†</sup> (0.25–0.69)	0.31 <sup>†</sup> (0.16–0.56)	0.55 <sup>†</sup> (0.38–0.85)	0.50 <sup>†</sup> (0.34–0.77)	–	–
Time to revision (days) <sup>  </sup>	221 ± 64	199 ± 177	280 ± 210	216 ± 234	217 ± 221	239 ± 230	0.60 <sup>‡</sup>
New York							
Revision rate	2.09%	0.97%	1.39%	1.28%	1.35%	1.71%	0.20 <sup>§</sup>
OR Relative to WC (95% CI)	1.17 (0.72–1.90)	0.55 (0.30–1.00)	0.78 (0.38–1.50)	0.72 (0.49–1.10)	0.77 (0.53–1.16)	–	–
Time to revision (days) <sup>  </sup>	290 ± 224	307 ± 232	179 ± 129	250 ± 234	260 ± 227	230 ± 185	0.89 <sup>‡</sup>
Pooled							
Revision rate	1.84%	0.98%	0.97%	1.42%	1.33%	2.06%	0.002 <sup>§</sup>
OR Relative to WC (95% CI)	0.88 (0.59–1.30)	0.50 <sup>†</sup> (0.34–0.73)	0.47 <sup>†</sup> (0.30–0.74)	0.67 <sup>†</sup> (0.51–0.90)	0.65 <sup>†</sup> (0.50–0.87)	–	–
Time to revision (days) <sup>  </sup>	283 ± 213	229 ± 198	236 ± 184	229 ± 234	234 ± 225	234 ± 206	0.55 <sup>‡</sup>

WC, workers' compensation.

\*Non-WC patient population is the pooled result of Medicaid, Medicare, Other, and Private.

<sup>†</sup>Indicates statistical significance by the 95% confidence interval of the odds ratio (OR) excluding 1.0, based on logistic regression (controlling for age, sex, race, and urban-rural location). Odds ratios less than 1.0 indicate that the payer group had a lower probability of revision than the WC group.

<sup>‡</sup>Mann-Whitney *U* test.

<sup>§</sup>Fisher exact test.

<sup>||</sup>Values are mean ± standard deviation.

New York. However, limiting access to surgery for indicated LDH patients may not be an ideal approach. Indicated patients who undergo discectomy experience greater and/or faster improvement in pain and function and have less productivity loss.<sup>7–11</sup> Lavin et al<sup>25</sup> reported that WC patients who had delayed lumbar spine surgery had claims costs that were 5.7 times greater than counterparts who had surgery early. In the current study, WC patients who received nonsurgical care (eg, epidural injection) for an LDH-related diagnosis returned for at least one additional LDH-related treatment in over 35% of cases. In contrast, those receiving surgery returned for additional treatment (surgical or nonsurgical) in less than 3% of cases. Since LDH is frequently associated with permanent partial disability status, the lost wage payments accumulating while a patient receives repeat nonsurgical care may offset the cost of surgery.<sup>11</sup>

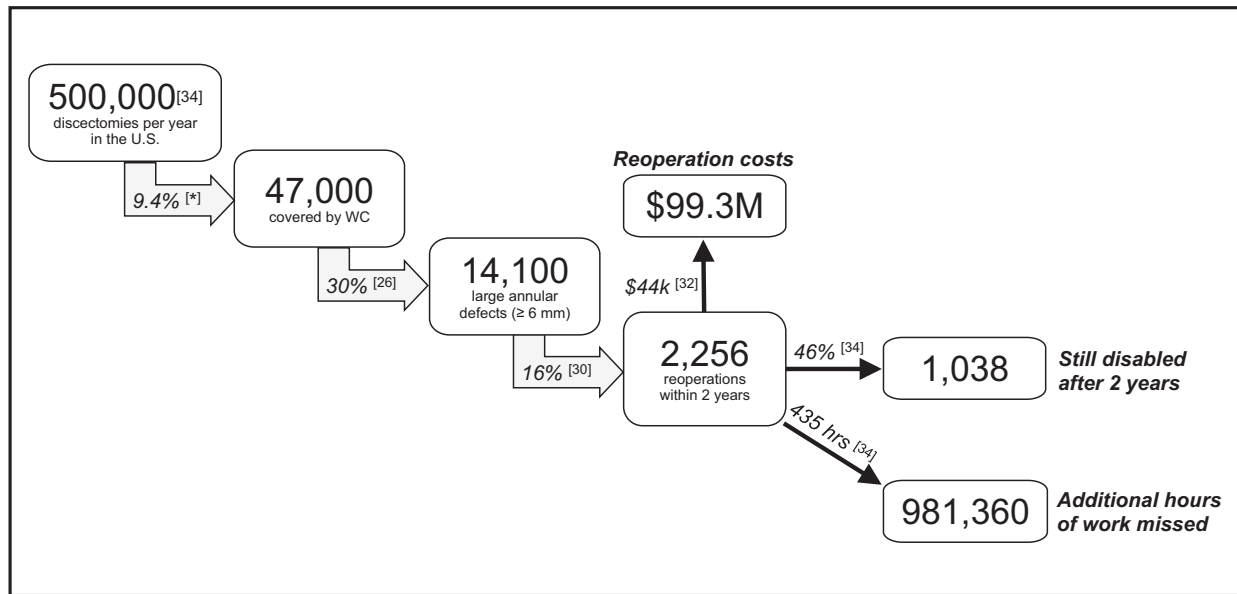
Rather than avoiding discectomy surgery in the WC population, it may be better for patients, employers, and WC programs to focus on controlling the recurrence and reoperation rates. As previously mentioned, the WC population includes patients—many of whom now have an annular defect—who are being reintroduced to jobs with repetitive lifting. If the risk of LDH recurrence and reoperation is higher in the WC population, improvements to the current discectomy technique may be critical for advancing care in this population. This could include modification of surgical technique (when appropriate) to minimize annular disruption. Miller et al<sup>26</sup> demonstrated that large annular defects (more than or equal to 6 mm wide) are associated with a 2.5-fold increased risk of recurrent disc herniation. However, avoiding a large annular defect is not always possible, either due to a large primary defect occurring at the time of disc herniation, or when a large iatrogenic defect is required for surgical success. In these cases, bone-anchored annular closure has been shown to prevent over 50% of reoperations for recurrent herniation and achieve significantly improved outcomes in indicated patients.<sup>27–31</sup>

The effects of revision discectomy are burdensome from financial, physical, and productivity standpoints. Revision surgery accumulates an additional \$44,000 per case in direct medical costs,<sup>32</sup> increases missed work time by an average of 435 hours

per worker,<sup>24</sup> and results in approximately 3-fold more patients who fail to improve in disability or pain scores.<sup>24</sup> The additional missed work and persistent disability have important implications for costs to cover lost wages. In Florida, between 2014 and 2016, the average indemnities for any WC back injury case were \$7,800 per case and the average settlement was \$24,000 per case.<sup>33</sup> Assuming 500,000 discectomies annually in the United States,<sup>34</sup> with 9.4% covered by WC programs [current analysis], and a 30% incidence of large annular defects,<sup>26</sup> there would be over 14,000 WC patients at an elevated risk for recurrent herniation each year. With a reoperation rate of 16% among patients with large annular defects,<sup>30</sup> this translates to nearly \$100 million in medical costs for reoperation and nearly 1 million additional hours of missed work (Fig. 3).

Controlling the risk of revision surgery through annular repair could help manage this socioeconomic burden. With a bone-anchored annular closure device preventing more than 50% of reoperations, the costs for medical and indemnity benefits could be greatly reduced. For example, if 50% of the reoperations described in Fig. 3 were avoided through annular repair, this would save \$49.6M in direct medical costs, avoid 491,000 hours of missed work, and save over 500 patients from continued disability. Accordingly, in a cost-effectiveness analysis, Ament et al<sup>35</sup> reported that bone-anchored annular closure was economically dominant (improved outcomes at a lower overall cost) compared with discectomy alone when productivity loss is considered.

While this study provides important insights regarding the discectomy populations in two large WC states, retrospective database analyses are limited to the available information. Since WC payers and policies vary by state, the findings may not be generalizable beyond Florida and New York. The HCUP databases are cleaned and validated, but it is possible for codes to be missing or misclassified. CPT codes do not specify the spinal level of discectomy, so it is not possible to ensure the revision procedures occurred at the same level. Additionally, administrative databases such as HCUP are limited in diagnostic details and patient characteristics. Understanding the type, size, and level of disc herniation is important information for making comparisons between groups and would greatly benefit future studies. That is, the specific



**FIGURE 3.** Estimated socioeconomic impact of reoperation among WC patients with large annular defects. \* 9.4% is the pooled rate of discectomy procedures covered by WC in the current analysis. WC, workers' compensation.

characteristics of the herniations may lend information toward determining the risk factors for recurrence in this patient population and help define the sub-populations that may benefit from different interventions. The risk of bias related to missing CPT codes or payer information is low, considering the high frequency of complete records (Fig. 1). Further studies will be important to better understand the risk of reoperation in the WC populations and the potential for annular repair to improve outcomes.

Overall, LDH is one of the most challenging diagnoses for WC programs, employers, and patients, as it has one of the highest indemnity severities and frequently results in permanent partial disability. WC patients undergo discectomy significantly less often than non-WC patients with the same diagnoses, despite the superiority of discectomy over continued nonsurgical care among indicated patients. For WC patients who did undergo discectomy, the revision rate was significantly greater than that observed for non-WC patients. Considering the importance of helping employees recover from LDH, return to work, and stay at work by avoiding symptom recurrence, new evidence-based treatment techniques, such as bone-anchored annular closure, may be critical to advancing care in this population and could result in significantly improved outcomes.<sup>28,29</sup>

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