Impacts of Adherence to Evidence-Based Medicine Guidelines for the Management of Acute Low Back Pain on Costs of Worker's Compensation Claims

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Objective: American College of Occupational and Environmental Medicine's (ACOEM's) evidence-based guidelines for acute low back pain (LBP) were used to assess relationships between guideline adherence and worker's compensation costs. **Methods:** Treatments at first appointments were abstracted. Two scoring tools were utilized to assess each patient's treatment plan. One score assessed ACOEM Guideline compliance while the second utilized mean expert scores of the perceived value of each treatment. Claim costs were log-transformed and compared with scores. **Results:** There is a significant trend between increased compliance and decreasing costs. Medical and total costs trended lower by an average $352.90 and $586.20 per unit of compliance score respectively. No outlier cost claims were in the best guidelines compliance groups. **Conclusion:** This study shows a statistically significant trend in the relationship between adherence to ACOEM guidelines for initial management of work-related LBP and decreasing claim costs.

Keywords: compliance, costs, guidelines, healthcare, low back pain, occupation, outcomes, treatments, work, worker's compensation

Learning Objectives

- Discuss the rationale for and methods of the new study evaluating the association between adherence to evidence-based guidelines and clinical outcomes of work-related low back pain (LBP).
- Summarize the workers' compensation cost impact of increased guideline compliance, based on two scoring tools.
- Discuss the implications for reducing costs while improving outcomes for injured workers with LBP.

Low back pain (LBP) is a leading cause of acute care visits for work related injuries with an incidence rate of 20 per 10,000 full-time workers and an average of 7 days away from work per injury.[1,2] LBP accounts for up to 33% of workers' compensation costs.[3] LBP is also consistently one of the top reasons for all healthcare visits.[4] Symptoms of pain and disability, as well as the patient's potential to return to work, typically improve rapidly in the first month.[5] However, up to 33% report persistent back pain of at least moderate intensity up to 1 year after an acute episode, with approximately 20% reporting substantial limitations in activity.[6] Additionally, approximately 5% of people with disability related to back pain account for over 75% of LBP-associated costs.[7]

Medical treatment quality and costs vary widely for any given medical condition.[8] Determining the inherent value and quality of the medical care that is provided can be difficult, as many aspects of the initial injury and subsequent care may be situational and unique.[9] Yet, there is consensus that certain LBP treatments are not indicated including polypharmacy, early imaging, bed rest, excessive passive modalities or ongoing manipulation without incremental functional gains.[10–15] Given the national opioid epidemic, the use of opioids is of particular concern as research suggests that these medications are associated with poorer outcomes, longer duration of back pain and disability, greater risk of spine surgery, and increased costs.[10,16–18]

Numerous evidence based medicine (EBM) guidelines have been developed to improve quality and effectiveness of care.[19,20] The American College of Occupational and Environmental Medicine's peer-reviewed Low Back Disorders guideline[21] ("American College of Occupational and Environmental Medicine [ACOEM] Guidelines") identifies evidence-based treatments for efficacious treatment of LBP.[21] In addition to the ACOEM Guidelines' evidence summaries, the algorithms assist with expert consensus on sequencing treatment approaches. There is increasing interest to use guidelines to accelerate healing, reduce variance, improve outcomes, improve the risk-to-benefit ratio, control costs, and subsequently standardize the care that is provided. Some evidence has begun to suggest that a healthcare provider's adherence to EBM guidelines may be associated with improved outcomes and/or lower costs.[22,23]

We hypothesized that the initial healthcare treatments prescribed for acute LBP having greater compliance with the ACOEM Guidelines are associated with improved clinical outcomes as measured by the cost of the injured worker's LBP case. We secondarily hypothesized that a weighted expert opinion rating of treatment strategies may provide a stronger relationship than a binary assessment of compliance with the ACOEM Guidelines used for the primary analyses.

METHODS

Institutional review board approval was received for this study. Data were collected and analyzed from the Worker's Compensation Fund (WCF) Insurance of Utah, the state's largest worker's compensation insurance carrier and its insurer of last resort. WCF covers approximately 50% of the insured market in Utah and maintains a comprehensive computerized databases of records for each case, including medical records, treatment instructions provided to patients, duration of claim, claims costs, and indemnity cost data. A trained Research Team collected the data. The year 2015 was chosen in order to ensure that nearly all, if not all claims would be closed. The goal was to randomly analyze approximately

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100 cases of acute LBP. LBP cases were enrolled by the Research Team while blinded to cost and duration data.

The database containing all WCF claims was used to select LBP cases. The inclusion criteria were all claims for acute LBP requiring healthcare treatment with onset in 2015 and no more than 2 weeks between onset of LBP and treatment. Exclusion criteria were a history of spine fusion, spinal fracture, or major trauma (eg, a fall from height greater than 4 ft., or a motor vehicle crash with fractures or internal trauma). Otherwise, LBP cases resulting from accidents and crashes were included.

A stratified enrollment process using a computer-generated list was used to enroll a sufficient variance in treatment complexity and probable guideline compliance. Four binary stratified enrollment criteria were used: (1) more than one healthcare provider involved, (2) opioids prescribed, (3) bed rest prescribed, and (4) treatment lacking physical activity recommendations. Each LBP case was then scored 0 to 4 based on these criteria, resulting in five enrollment bins (0, 1, 2, 3, 4). After any one of the five bins was filled, the stratified random enrollment process continued to fill subsequent bins. As there was a relative dearth of cases in bins 0, 3, and 4, the process was modified to over-enroll in the other bins to achieve 100 acute LBP cases.

A Research Team member next abstracted data for each enrolled acute LBP case into a database used for these analyses. Data were collected by reviewing the first treatment record. Data abstracted included: diagnosis code, age, sex, type of work/industry, mechanism of injury, pain score (0 to 10), all current medications (including prior prescriptions), location of initial treatment (ie, emergency department, urgent care, primary care, occupational medicine, orthopedics, physical medicine and rehabilitation, unknown or other), as well as type of treating provider (ie, physician, nurse practitioner, physician assistant, chiropractor, unknown or other).

The types of prescribed treatments at the first encounter were captured. The categories used were constructed after a pilot study was performed. The categories used were: directional stretch, slump stretch, progressive walking program, ''stay active'' recommendation (eg, aerobic exercise, swimming, etc), bed rest, full work duty, ''light duty'' without specifics, specific limitations (eg, 10 pounds lifting limit), manipulation, manual therapy, electrical stimulation, ultrasound, ice/heat recommendation for home use, ice (cryotherapy)/heat therapy performed at healthcare appointment (eg, at physical therapy or chiropractor), non-steroidal anti-inflammatory drug (NSAID) over-the-counter recommended, NSAID prescribed, muscle relaxant prescribed as needed (PRN), muscle relaxant scheduled (twice or thrice daily), glucocorticosteroid prescribed (eg, steroid dose pack), opioids prescribed, ketorolac injection, x-rays, and magnetic resonance imaging or computerized tomography (see Table 1).

The cost data were located in a different database than the other healthcare data. To further assure blinding of the outcomes data during the records abstractions, a separate researcher (M.S.T.) collected all cost data (medical and total claim costs) after all healthcare treatment data were collected and by using the claim number as the sole identifier. Figure 1 shows how cases were selected at random from a total pool of 2200 acute LBP cases to result in the 105 cases included in the analyses. A total of nine cases were excluded: six of these were excluded due to $0 cost, which typically occurs when an incident occurs at the workplace, is recorded, but no medical costs are subsequently incurred; and three cases were excluded due to lack of cost data.

The ACOEM Guidelines[21] were utilized to assess the degree to which each acute LBP case's treatment was compliant with evidence-based guidelines. Two distinct predictive tools were developed from the ACOEM Guidelines to analyze compliance with the ACOEM Guidelines (see Table 1). One tool was unweighted and simply assessed whether or not a treatment was recommended in the ACOEM Guidelines for management of acute LBP. The treatments prescribed at the initial encounter were scored based on the ACOEM Guidelines as +1 if the treatment is recommended, and −1 if it is not recommended for treatment of acute LBP.[24]

TABLE 1. Scores Assigned for Each Treatment Prescribed at the Initial Visit for Acute LBP

Treatments Encountered in Initial Encounter for Low Back Pain, Along with Attributable Scores from Each of the Scoring Tools	ACOEM Scores* (+1/−1)	Averaged Expert Rating Scores† Range +5 to −5 (±SD)
Progressive walking program	1	4.23 (±1.36)
''Stay active'' recommendation	1	3.84 (±1.46)
Directional stretch	1	3.76 (±1.48)
Specific limitations (eg, 10 lbs. lifting limit)	0	3.46 (±1.50)
NSAID OTC recommended	1	3.46 (±1.39)
Slump stretch	1	3.15 (±1.86)
NSAID prescribed	1	2.30 (±2.05)
Ice/heat recommendation for home	1	1.76 (±1.42)
Full work duty	0	1.53 (±3.23)
Manual therapy	0	0.30 (±2.49)
Manipulation	1	−0.07 (±2.56)
Ketorolac shot	1	−0.77 (±2.48)
Cryotherapy/heat therapy at appointment	−1	−1 (±1.52)
Muscle relaxant PRN	1	−1.07 (±2.92)
''Light Duty'' without specifics	0	−1.38 (±1.85)
Electrical stimulation or other electrical	−1	−1.61 (±1.89)
Ultrasound	−1	−1.76 (±1.92)
Muscle relaxant scheduled (eg, 3×/d)	1	−2.15 (±2.23)
X-rays of low back	−1	−3.07 (±1.70)
Glucocorticosteroid prescribed	−1	−3.23 (±2.27)
MRI (or CT)	−1	−3.84 (±1.67)
Opioids prescribed	−1	−4.46 (±1.19)
Bed rest	−1	−5 (±0)

CT, computerized tomography; MRI, magnetic resonance imaging.

*An ACOEM score of +1 means a treatment or test that is recommended by the ACOEM LBP Disorders Guideline, while 0 means no recommendation and −1 means the guidelines have a recommendation against.[22]

†Expert rating scores are an average score from 15 board-certified occupational medicine experts who separately scored each treatment or test based on each expert's opinion regarding the degree to which the treatment or test was unhelpful (−5) to helpful (+5).

A second scoring tool also relied upon the ACOEM Guidelines but was a weighted score. The ''Expert Rating Score'' was developed through a survey of 15 highly experienced, board-certified occupational medicine physician experts from across the United States. A de-identified survey instrument was used by each expert to rate the degree to which a given treatment was felt to foster or hinder resolution of acute LBP. Each treatment's score could range from +5 if the expert felt it was strongly indicated for initial management of acute LBP to −5 if strongly not recommended; thus, for example, a score of 3 could be considered to be moderately helpful treatment, 0 no difference, and −3 could be considered a moderately unhelpful treatment. The responses of the 15 physicians were averaged to create the ''Expert Rating Scores.'' Table 1 shows the scoring assigned to each treatment for both predictive tools.

Statistical Analyses

Statistical analyses were performed using SAS 9.4. Descriptive statistics including means, medians, standard deviations, quartiles, and ranges were calculated. Data were analyzed for normality and skewness.

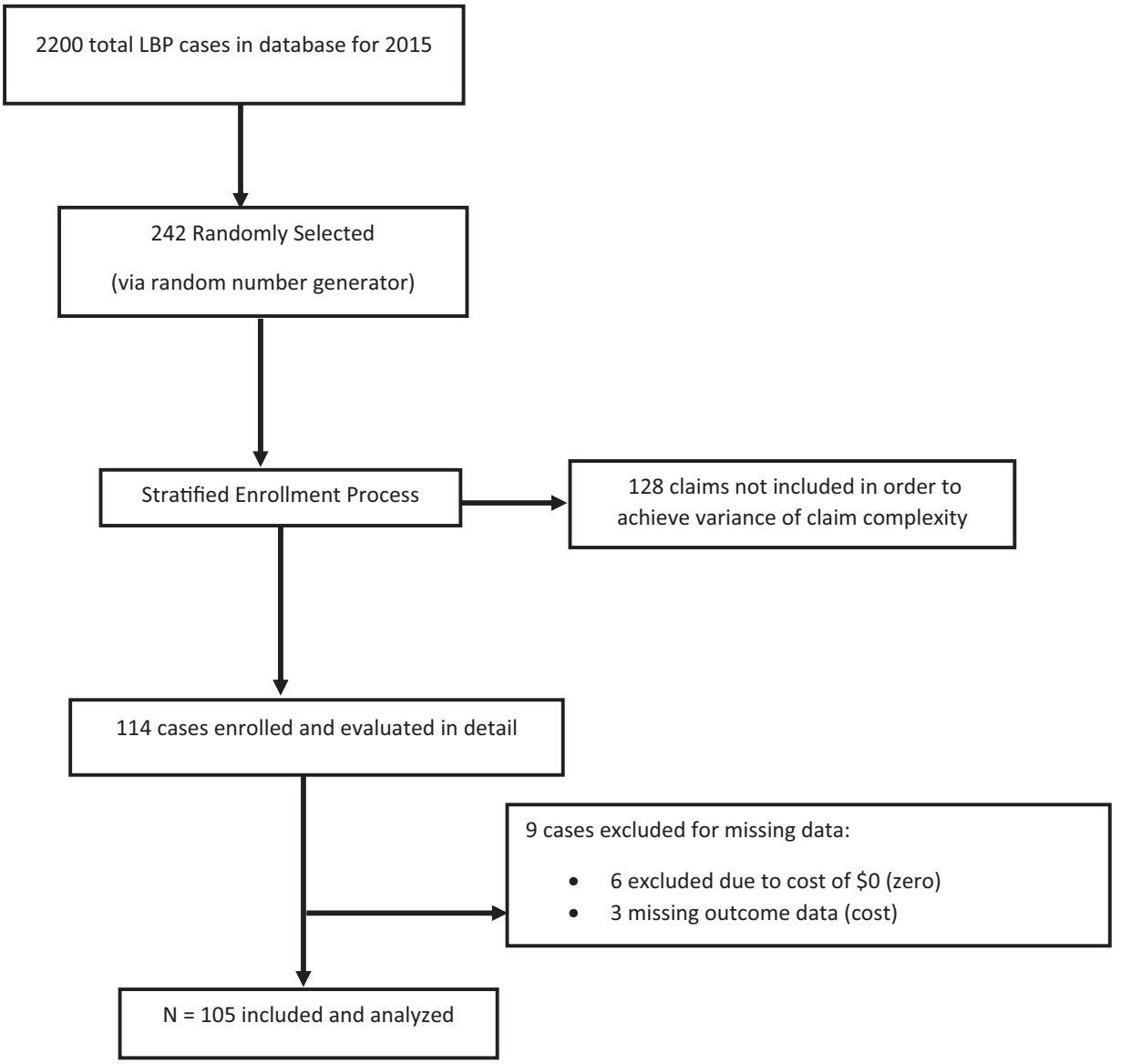

FIGURE 1. The randomization and selection process for acute low back pain cases used in these analyses.

Cost data were collected for both medical costs and total claim costs. For analyses, costs were evaluated using both a generalized linear model, (costs associated with each claim) and a post hoc non-linear, log-transformed approach to better account for skewed cost distribution and cost outliers. Both approaches help to evaluate the association between the continuous dependent variable (or outcome variable) of costs associated with the acute LBP case, and the discrete independent variable, the tool predictor score.[25] An alpha level of 0.05 was chosen for determining statistical significance. This study's controls are embedded, as they are those cases with high adherence to treatment guidelines.

RESULTS

A total of 105 cases were included in the analyses. The population was 53.3% men (see Table 2). Pain rating at the initial medical evaluation was not listed for 30 (28.6%) of the claims. Of those claims with a pain rating, the median pain score was 7. The average age was 38.7 (±12.4 years). The cumulative score for each claim using the ACOEM +1/−1 scoring tool ranged from −3 to +6, with a median score of +1. The cumulative score for the same claims using the Expert Rating Score tool ranged from −11.7 to +14.8, with a median score of 1.99. Both the medical costs, and the total costs incurred for the claims are also provided in Table 2. The costs of LBP cases are positively skewed; with higher number of lower costs claims, as many claims are often resolved in one or two visits.

Figure 2 shows the relationship between medical costs which trended lower with increasing compliance based on the ACOEM +1/−1 scoring. Each unit increase in ACOEM +1/−1 compliance score was associated with an average $352.90 in lower costs, although this trend was borderline significant ($P = 0.075$). The ACOEM +1/−1 Score was also compared with total costs (not shown), which showed a similar trend, with each unit increase in compliance resulting in an average $586.20 in lower costs, although

TABLE 2. Descriptive Statistics for Low Back Pain Claims Data

Categorical Data ($N = 105$)		**Category**		**Frequency**
		Male		56 (53.3%)
		Female		49 (46.6%)
Initial pain rating:		Pain not listed		30 (28.6%)
		Pain of 1/10		0 (0%)
		Pain of 2/10		1 (0.9%)
		Pain of 3/10		4 (3.8%)
		Pain of 4/10		4 (3.8%)
		Pain of 5/10		12 (11.4%)
		Pain of 6/10		11 (10.5%)
		Pain of 7/10		17 (16.2%)
		Pain of 8/10		16 (15.2%)
		Pain of 9/10		6 (5.7%)
		Pain of 10/10		4 (3.8%)
Continuous Data	Mean (±SD)	Median	25–75 Quartile	Range
Age, yrs	38.7 (±12.4)	38.9	28.6–47.5	18.4–69.5
ACOEM +1/−1 score		1	0–2	9 (−3–6)
Expert rating score		1.99	−3.54–6.23	26.5 (−11.7–14.8)
Cost (medical)		$770	$343–1653	$0–24,327
Cost (total)		$987	$346–1914	$124–63,992

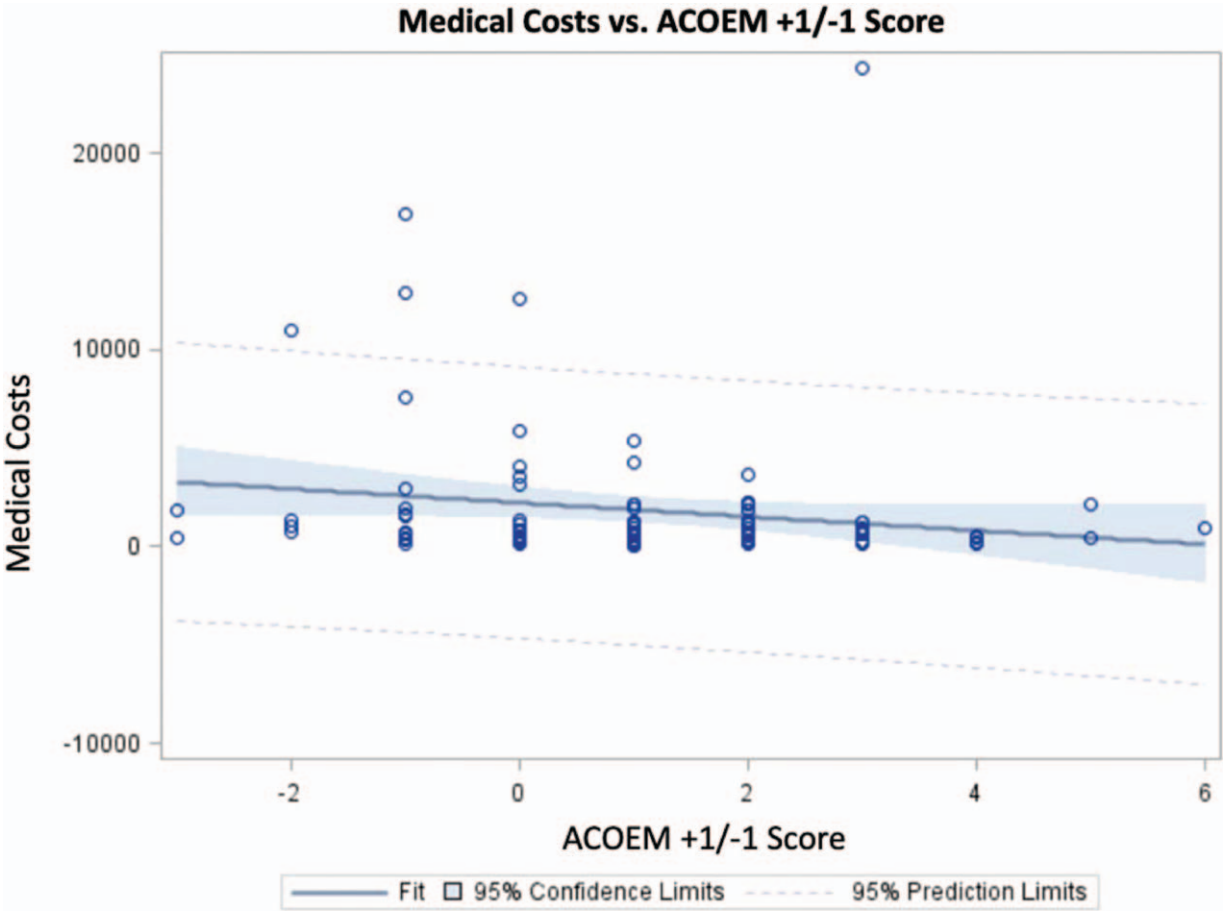

FIGURE 2. Trend of medical costs decreasing with each unit increase in the ACOEM Guidelines ''+1/−1'' compliance score for acute low back pain.

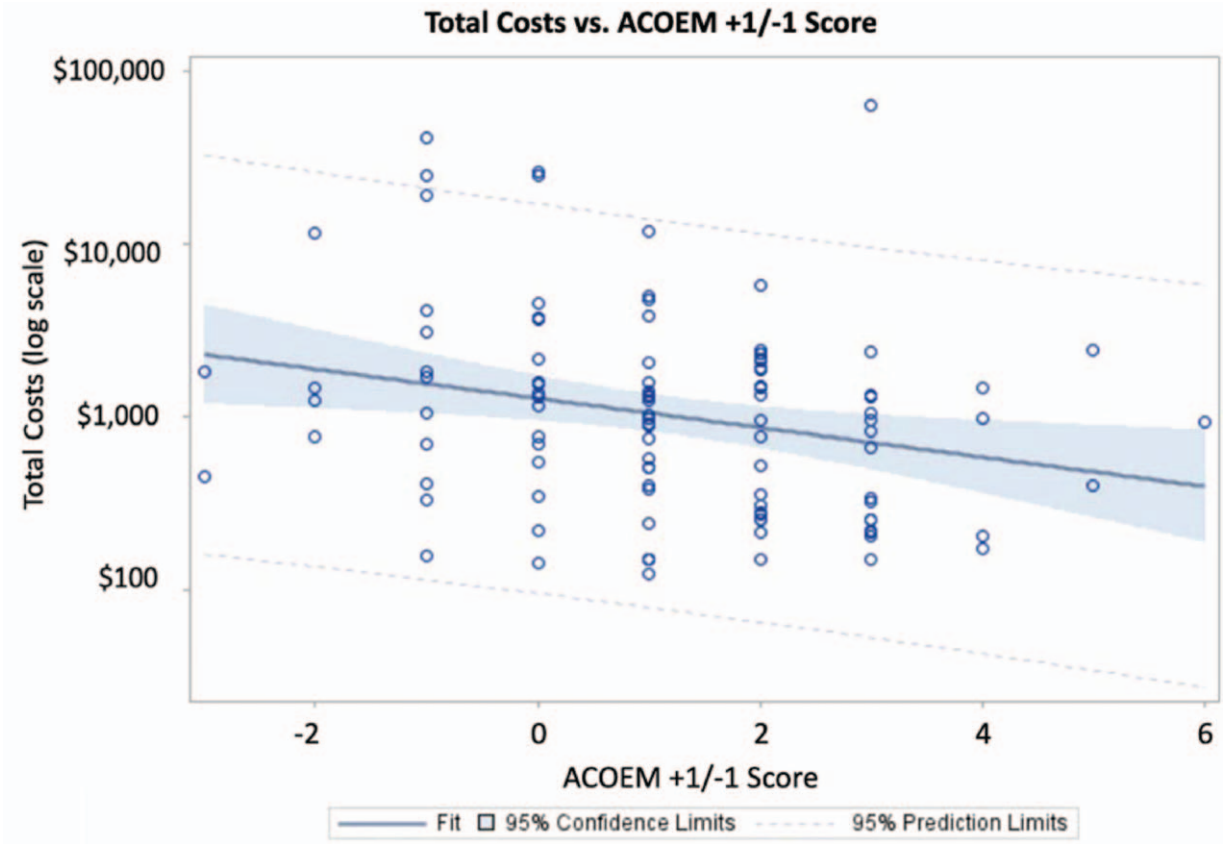

FIGURE 3. Statistically significant trend of total claim costs decreasing with each unit increase in the ACOEM Guidelines ''+1/−1'' compliance score for acute low back pain ($P = 0.0097$).

this trend was not statistically significant ($P = 0.22$). Interestingly, nearly all of the more expensive outliers are claims with lower scores, suggesting claims not managed in a manner compliant with ACOEM guidelines result in more expensive claims.

Costs were then log-transformed in ordered to better account for skewed cost distribution and outliers. The log-transformed total cost data as they relate to the ACOEM +1/−1 score are shown in Fig. 3. There is a statistically significant relationship ($P = 0.0097$) between decreasing claim's medical costs and increasing compliance with the ACOEM guidelines. There also were no statistical or meaningful differences in these strong relationships for either cost outcome after adjusting for potential confounders of age, sex, and pain rating using multivariate regression models. Furthermore, none of these potential confounders were independently related to the outcomes. Therefore, only the unadjusted relationships are shown for simplicity.

Figure 4 illustrates the relationship between medical costs and the Expert Rating Score. Each unit increase in the Expert Rating Score was associated with $85.73 in cost reduction, although this trend was borderline significant ($P = 0.128$). The Expert Rating Score was also compared with total costs (not shown), which showed a similar trend, with each nominal increase in compliance resulting in $145.03 in lower claims costs, although this trend was not significant ($P = 0.29$). Again, most of the outliers of more expensive claims lie on the ''less compliant'' half of the scores, suggesting again that claims not managed in a manner that is compliant with expert opinion of ACOEM guidelines result in a preponderance of the more expensive claims.

Total costs were again log-transformed to better account for skewed cost distribution and outliers. Figure 5 shows the log-transformed total cost data evaluated against the Expert Rating Score. The log-transformed cost results again demonstrate a strong, statistically significant, relationship ($P = 0.0043$) of the average claim's medical costs decreasing with increasing compliance with the Expert Rating Score. Again, there were no statistical or meaningful differences in these strong relationships for either cost outcome after adjusting for potential confounders of age, sex, and pain rating using multivariate regression models. Furthermore, none of these potential confounders were independently related to the outcomes. Therefore, only the unadjusted relationships are shown for simplicity.

DISCUSSION

This study of 105 worker's compensation claims for acute, work-related LBP found a significant trend of increasing medical and total claim costs with decreasing compliance with the ACOEM guidelines at the initial evaluation ($P = 0.0097$). A significant relationship was similarly found when total claim costs were assessed against an Occupational Medicine Expert Rating Score ($P = 0.0043$). As the mean ACOEM guidelines compliance score was only +1 and there was difficulty enrolling in the best ACOEM guidelines compliance score bin suggests that the treatment of many workers is not well aligned with the guidelines and thus, there is much room to both improve LBP outcomes and reduce costs.

Log-transformation of the cost data was performed to establish these significant trends in order to minimize the effects of outliers and skewed cost data and confirmed the results remained significant. When costs were not log-transformed, and each claim's costs were independently compared with the claim assigned scores,

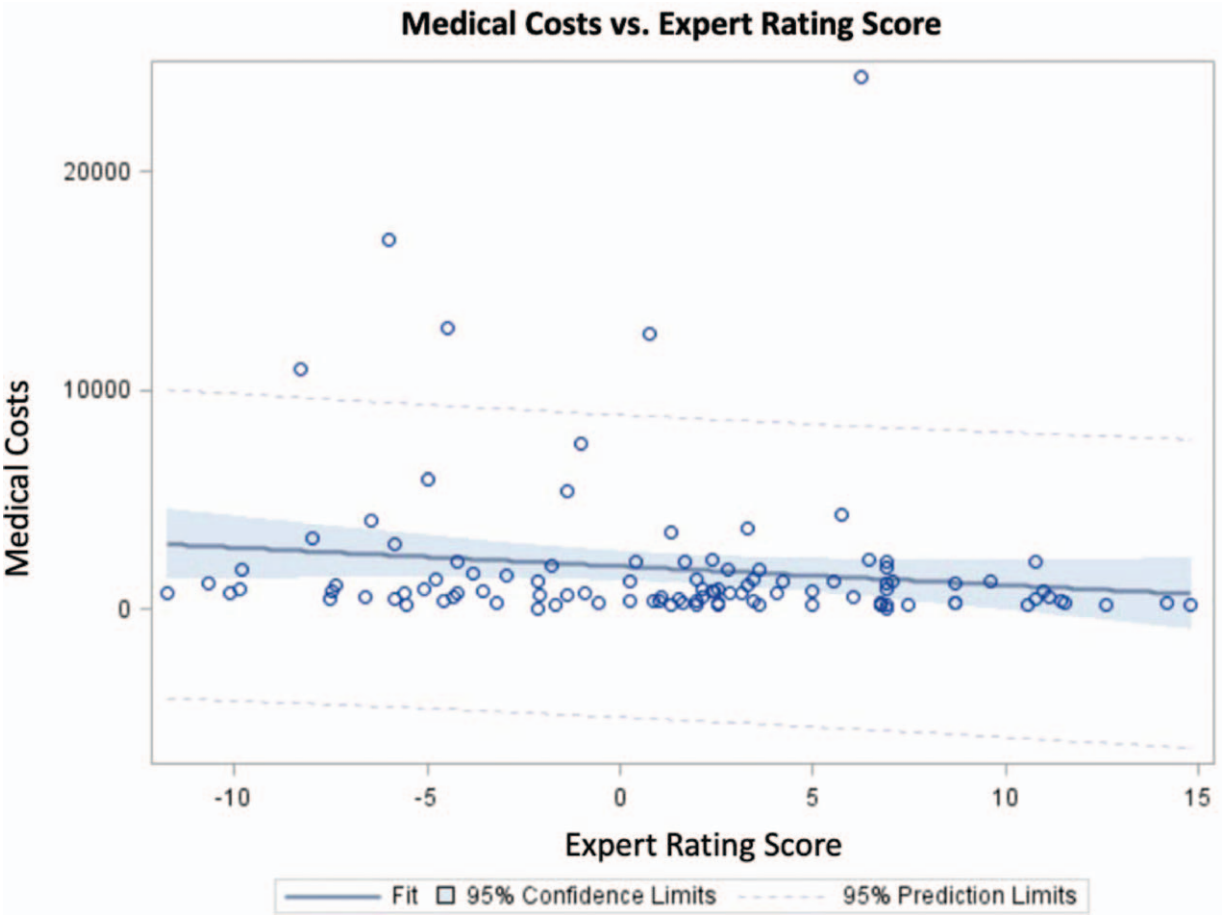

FIGURE 4. Trend in medical costs decreasing with increasing ''Expert Rating Scores'' of compliance with ACOEM Guidelines for low back pain ($P = 0.029$).

there is a quantifiable trend of $352.90 in lower costs per unit of increase in ACOEM +1/−1 Score at initial medical evaluation. Somewhat comparable results were found with the Expert Rating Score, with a reduction in health costs of $85.73 per unit for this scoring system, which also had a larger range in scores. These results suggest that adherence to ACOEM guidelines for the initial management of acute, work-related LBP results in substantially lower workers compensation costs, which is a surrogate for faster recovery and improved health outcomes.

Interestingly, the relationships were comparable between the ''Expert Scores'' and the ''+1/−1 ACOEM'' scoring. A priori, it was expected that the ''Expert Scores,'' which mostly concur with the ''+1/−1'' scores, would amplify the magnitude of perceived better (eg, specific exercise prescriptions) and worse treatments (eg, opioids) while providing a broader range in scores. As there were minimal differences in the outcomes using these two ratings, this may reflect that this was a study with 105 participants, and stronger differences may become more clearly defined with a larger sample size. It is also possible the experts' average assessments are incorrect regarding the relative impacts of some of the various treatments.

These results also suggest that ''over medicalizing'' with early interventions that add costs, such as radiological studies, passive modalities, or early referral to other treatments may also drive up costs without commensurate benefits. This indirectly infers that a ''less is more'' approach to initial management may be superior, including ruling out concerning pathology and ''red flag'' symptoms with a good history and examination, and then emphasizing self-care measures.

Utah is a state with considerably lower workers compensation costs compared with many other states.[26,27] Thus, the cost savings estimates in this study would be anticipated to potentially be far larger in high cost states.

Strengths of this study include use of population-based methods ascertaining cases from across the state of Utah, access to large databases from which to abstract cases, and implementation of a stratified randomization process to develop sufficient case variance for studying the outcomes. The blinded assessment of the outcomes measures was a significant study strength to prevent information bias. This study also had particular strengths in the availability of defined cost outcomes associated with each claim. Lastly, the use of the only national peer-reviewed guidelines for treatment of injured workers was a strength.

The primary limitation of this study was its modest sample size, although the randomization used for claim enrollment likely counters this limitation. While a larger sample size is unlikely to alter the fact that there is likely a true relationship, a larger sample size could easily alter the slopes of these relationships. A larger sample size could also result in statistical significance of a confounder, such as pain ratings. As an observational study, this study was also modestly limited by the variation in quality and

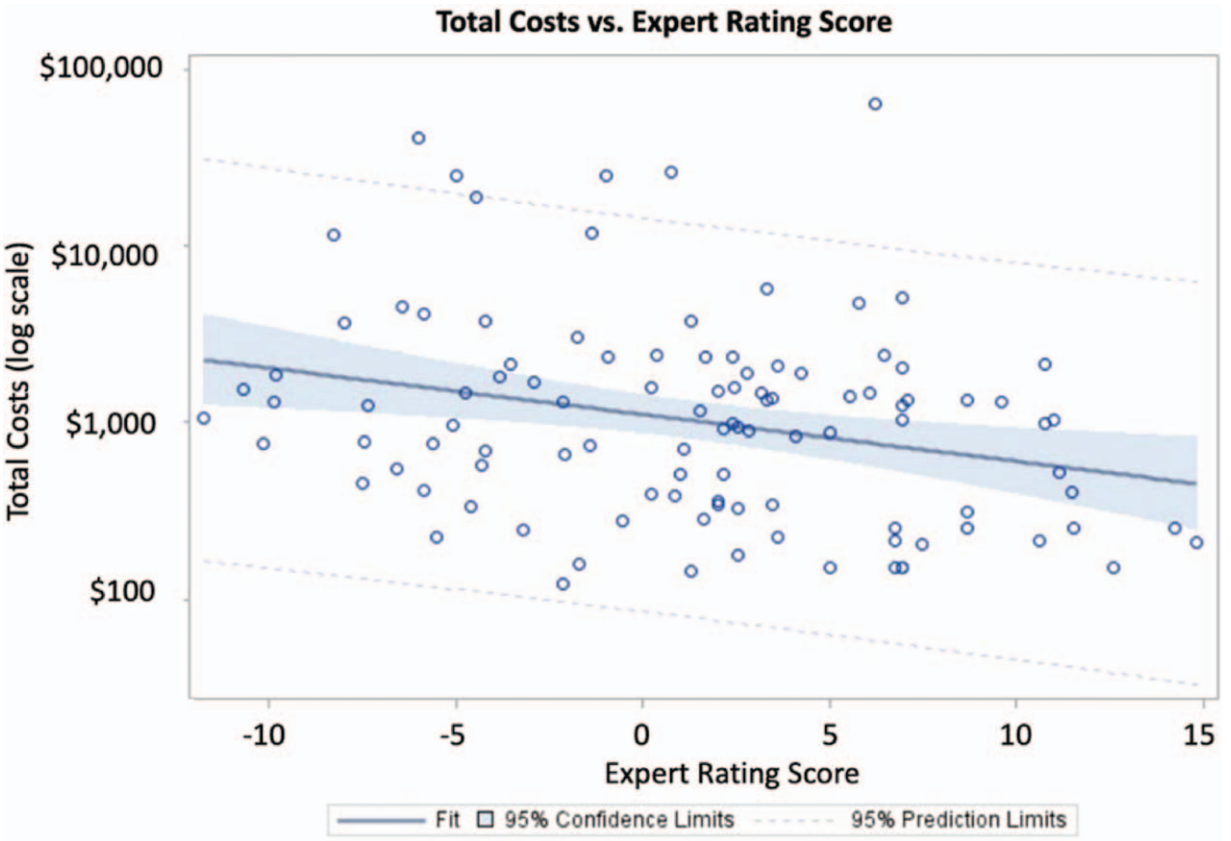

FIGURE 5. Statistically significant trend in total claim costs decreasing with increasing ''Expert Rating Scores'' of ACOEM Guidelines compliance for low back pain ($P = 0.0043$).

depth of the information available in the clinical records. Finally, only the first appointment was assessed, as there was much heterogeneity by the second appointment, especially in terms of type of healthcare provider and thus treatments administered. Development of additional analytical approaches to incorporate subsequent treatment effects and sequencing of treatments are needed.

CONCLUSION

This study demonstrates a statistically significant relationship between adherence to ACOEM guidelines for initial management of work-related acute LBP and decreasing claim costs. There was a borderline significant reduction in medical costs of $352.90 and total costs of $586.20 for each unit increase in ACOEM +1/−1 Score. Further studies with larger sample sizes would help further define these relationships. Inclusion of the entirety of the claim's treatment history would also be useful to evaluated influences of subsequent treatments. If further validated, the predictor score may be usable as a simple tool for healthcare system quality improvement projects. Additionally, this tool could be helpful in predicting outcomes based on the initial management of injured workers, and the predictor score may be useful for clinicians, employers and insurers alike to better gauge the prognosis of individuals with acute LBP.

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