TESTIMONY BY DR. JASON BROWN, SECRETARY

OF THE NEW YORK STATE CHIROPRACTIC ASSOCIATION,

BEFORE THE JOINT ASSEMBLY STANDING COMMITTEES ON LABOR AND INSURANCE

DECEMBER 19, 2014

THANK YOU CHAIRMAN HEASTIE AND CHAIRMAN CAHILL FOR GRANTING ME THE OPPORTUNITY TO PRESENT THIS TESTIMONY TODAY REGARDING THE PROPOSED WORKERS' COMPENSATION FEE SCHEDULE IN NEW YORK STATE.

MY NAME IS JASON BROWN, AND I CURRENTLY SERVE AS SECRETARY OF THE NEW YORK STATE CHIROPRACTIC ASSOCIATION (NYSCA) AND AS CO-CHAIR OF THE NYSCA WORKERS' COMPENSATION COMMITTEE. I ALSO SERVE INJURED WORKERS IN PRIVATE PRACTICE AS AN AUTHORIZED WORKERS COMPENSATION MEDICAL PROVIDER. I AM ALSO A BUSINESS OWNER WHO MAINTAINS WORKERS COMPENSATION INSURANCE FOR MY EMPLOYEES AND FURTHER SEEK TO ENSURE THAT THEIR RIGHTS ARE NOT FURTHER ENCROACHED UPON. I WANT TO THANK YOU FOR TAKING THE TIME TO HOLD THIS HEARING AND TO EXAMINE THE ISSUES SURROUNDING THE IMPLEMENTATION OF A NEW PROPOSED FEE SCHEDULE FOR HEALTH CARE PROVIDERS WITHIN THE WORKERS COMPENSATION SYSTEM.

WHILE NYSCA FULLY AGREES THAT THE FEE SCHEDULE NEEDS TO BE UPDATED, WE STRONGLY FEEL THAT THE METHOD AND MANNER BY WHICH IT IS TO BE DONE MUST BE ACCURATE, COMPLETE AND WITHOUT BIAS. ANYTHING LESS WILL HAVE NEGATIVE IMPACTS ON THE HEALTH AND WELFARE OF NEW YORK'S INJURED WORKERS, THE BUSINESSES THAT EMPLOY THEM, AND THE ECONOMY IN NEW YORK.

REGARDING THE PROPOSED UPDATES TO THE WC MEDICAL FEE SCHEDULE, WE HAVE THREE MAIN AREAS OF CONCERN. 1) THE INCONGRUENCE OF MEDICARE AND WORKERS COMPENSATION, 2) THE INCONSISTENCY BETWEEN THE MEDICAL TREATMENT GUIDELINES AND THE FEE SCHEDULE, AND 3) THE LACK OF PARITY IN CERTAIN FEES BETWEEN PROVIDER TYPES.

AS QUICK BACKGROUND, THE WORKERS COMPENSATION FEE SCHEDULE PREVIOUSLY ALLOWED LIMITED CODING FOR CHIROPRACTORS WITH MOST SERVICES BEING BILLED UNDER A GENERAL "OFFICE VISIT" CODE. WITH THE ADOPTION OF THE 2010 MEDICAL TREATMENT GUIDELINES, THE WCB DECIDED TO ALLOW MORE ACCURATE CODING WHERE EACH SERVICE WOULD BE BILLED INDIVIDUALLY (AS IS CUSTOMARY FOR MEDICARE AND MAJOR MEDICAL INSURANCE). THE CHIROPRACTIC PROFESSION VIEWED THIS AS A POSITIVE STEP FORWARD AS WE COULD NOW DOCUMENT AND DEMONSTRATE THE FULL BREADTH OF SERVICES WE PROVIDED INJURED WORKERS AND CARRIERS COULD RIGHTFULLY UNDERSTAND WHAT THEY WERE PAYING FOR. IT IS WELL

UNDERSTOOD THAT BUNDLING SERVICES INTO ONE FEE RESULTS IN MINIMALISTIC CARE, WHICH IS CONTRARY TO EXPEDITING RETURN TO WORK AND RECOVERY. IT ALSO ALLOWED ALL PARTIES TO SEE HOW TREATMENT AND BILLING FOLLOWED THE MEDICAL TREATMENT GUIDELINES. AT PRESENT, THE PROPOSED FEE SCHEDULE AS IT RELATES TO CHIROPRACTIC CARE WOULD REVERT TO A SYSTEM OF LIMITED AND BUNDLED CODES WHICH DO NOT REFLECT THE EXTENT OR DEGREE OF SERVICE(S) PROVIDED. THIS STEP BACKWARD WILL UNAVOIDABLY AFFECT PATIENT CARE, BOTH IN QUALITY AND TIMELINESS, AND FURTHER DRIVE UP COSTS RELATIVE TO PATIENT CARE, TEMPORARY DISABILITY, AND PERHAPS EVEN PERMANENCY. THIS IN TURN COULD FURTHER INCREASE PREMIUMS – WHICH, AS YOU ARE AWARE, ARE AMONGST THE HIGHEST IN THE NATION.

ONE OF THE MAIN CONCERNS THAT WE HAVE WITH THIS PROPOSED FEE SCHEDULE IS THAT THE MEDICARE FEE SCHEDULE, ON WHICH THIS PROPOSED FEE SCHEDULE IS BASED, HAS LIMITATIONS AND FLAWS. NYSCA FEELS THAT CARRYING THE LIMITATIONS AND FLAWS OF MEDICARE TO NYS WC IS INAPPROPRIATE AND INCOMPLETE. MEDICARE AFFORDS REIMBURSEMENT TO CHIROPRACTORS FOR MANUAL MANIPULATION OF THE SPINE ONLY. ALL OTHER SERVICES ARE CONSIDERED NON-COVERED, AND THE FISCAL RESPONSIBILITY OF THE PATIENT. THIS INCLUDES PHYSICAL EXAMINATIONS, DIAGNOSTIC TESTING SUCH AS X-RAYS AND ELECTRODIAGNOSIS, THERAPEUTIC EXERCISE TO REHABILITATE OUR PATIENTS, AND MODALITIES FOR

CONTROLLING PAIN SUCH AS ULTRASOUND. IT IS IMPORTANT TO NOTE THAT WHILE MEDICARE DOESN'T COVER THESE SERVICES, THEY DO PERMIT A CHIROPRACTOR TO PERFORM THEM AND REIMBURSEMENT IS THE RESPONSIBILITY OF A SECONDARY INSURANCE COMPANY OR THE PATIENT THEMSELVES. CLEARLY THIS MODEL CANNOT BE CARRIED DIRECTLY INTO NYS WORKERS COMPENSATION.

THESE CONCERNS HAVE BEEN DISCUSSED WITH THE WCB, AND WHILE NYSCA DOES ACKNOWLEDGE THAT SOME INCORPORATION OF THESE CONCEPTS BY THE WORKERS COMPENSATION BOARD HAS OCCURRED AS IT RELATES TO THE CHIROPRACTIC FEE SCHEDULE, THERE ARE STILL LIMITATIONS AND CONCERNS. FOR EXAMPLE, THE PROPOSED FEE SCHEDULE RECOGNIZES THAT EVALUATION AND MANAGEMENT SERVICES, WHICH INCLUDE PHYSICAL EXAMINATION OF A NEW OR ESTABLISHED PATIENT, IS NECESSARY AND SHOULD BE COMPENSATED. HOWEVER, THEY HAVE CHOSEN TO DO SO VERY SELECTIVELY. EVALUATION AND MANAGEMENT (E/M) SERVICES ARE CODED BY ALL PROFESSIONS ACCORDING TO STANDARD CODING METHODS, COMMON PROCEDURE TERMINOLOGY (CPT), WITH EXAMS HAVING 5 DIFFERENT LEVELS RANGING FROM SIMPLE DECISION MAKING TO COMPLEX. WHILE E/M SERVICES WERE ADDED TO THE SCHEDULE, ONLY THE MINIMUM-LEVEL CODE FOR NEW PATIENTS AND ONE LOW-LEVEL CODE FOR ESTABLISHED PATIENTS WAS SELECTED. THE STANDARD PHYSICAL EXAMINATION COMPONENTS OUTLINED IN THE MEDICAL TREATMENT GUIDELINES DICTATE THAT A MID LEVEL CODE

WOULD BE MOST OFTEN APPROPRIATE AND SOME CASES WILL WARRANT HIGH LEVEL EXAMINATIONS. THIS PLACES THE AUTHORIZED TREATING PROVIDER IN A PLACE WHERE THEY EITHER PROVIDE A LOWER LEVEL OF SERVICE THAN THAT REQUIRED TO EVALUATE THE INJURED WORKER / OUR PATIENT, OR PROVIDE THE MEDICALLY NECESSARY SERVICE AND INCORRECTLY CODE IT TO MATCH THE NYS WC FEE SCHEDULE. WE DO NOT BELIEVE THAT LIMITING CHIROPRACTORS TO LOW LEVEL E/M CODE SERVICES ENCOURAGES THE SHARED GOAL OF APPROPRIATE, QUALITY HEALTH CARE FOR NEW YORK'S INJURED WORKERS. FURTHERMORE, ACCORDING TO CENTER FOR MEDICARE AND MEDICAID SERVICES (CMS), PURPOSEFULLY DOWNCODING A SERVICE TO SEEK REIMBURSEMENT IS CONSIDERED FRAUDULENT BILLING. WE DO NOT BELIEVE IT IS THE INTENT OF THE WCB OR STATE OF NEW YORK TO ENCOURAGE SUCH ACTIVITIES – WHETHER UPCODING OR DOWNCODING.

SIMILARLY, ACTIVE THERAPIES INCLUDING THERAPEUTIC EXERCISE AND NEUROMUSCULAR REEDUCATION ARE OFTEN NECESSARY COMPONENTS OF CONSERVATIVE CARE. WHILE THESE SERVICES ARE NOT COVERED BY MEDICARE WHEN RENDERED BY A DOCTOR OF CHIROPRACTIC, THEY ARE ALLOWED BY MEDICARE, AND ALSO COVERED SERVICES PER MOST MAJOR MEDICAL CARRIERS. ACTIVE THERAPIES ARE CURRENTLY ON THE NYS WC CHIROPRACTIC FEE SCHEDULE AND SHOULD REMAIN SO. ACTIVE THERAPIES ARE INCORPORATED AND ENCOURAGED THROUGHOUT ALL OF NEW YORK'S MEDICAL TREATMENT GUIDELINES – WHETHER IN THE GENERAL GUIDING

PRINCIPALS, OR AS RECOMMENDED INDIVIDUAL TREATMENT PROCEDURES. AT PRESENT, THE PROPOSAL IS TO ONLY INCORPORATE ONE SPECIFIC CODE, 97530. AS OTHER COMMONLY USED CODES, SUCH AS 97110 AND 97112, ARE OF SIMILAR RELATIVE VALUES TO THE PROPOSED INCLUSION, AND ACTIVE CARE CODES ARE SELECTED BASED ON THE NEEDS OF THE PATIENT AND GOAL OF THE TREATMENT, WE DO NOT SEE A REASON TO LIMIT THIS CATEGORY TO ONE CODE. BROADER INCLUSION WOULD FACILITATE PROPER TREATMENT AND CODING, WHILE BEST SERVING THE NEEDS OF THE INJURED WORKER.

FURTHER, WHILE SOME MODIFICATIONS HAVE BEEN MADE TO THE PROPOSED EVALUATION AND MANAGEMENT AND ACTIVE CARE SECTIONS, AT PRESENT THERE HAS BEEN NO INCORPORATION OF COMMONLY USED PASSIVE THERAPIES SUCH AS ELECTRICAL STIMULATION, THERAPEUTIC ULTRASOUND, MYOFASCIAL RELEASE, TRACTION, AND OTHER FORMS OF MANUAL THERAPY. THIS IS INAPPROPRIATE, INSUFFICIENT, AND INCONSISTENT WITH THE RECOMMENDATIONS OF THE MEDICAL TREATMENT GUIDELINES THEMSELVES. THESE FORMS OF THERAPY ARE OFTEN USED IN SYMPTOM MANAGEMENT IN ACUTE AND SUBACUTE PHASES, INCLUDING FOLLOWING EXACERBATION, TO HELP CONTROL PAIN AND FACILITATE PROGRESS INTO ACTIVE MANAGEMENT. REIMBURSEMENT FOR THESE RECOMMENDED SERVICES IS INCLUDED WITHIN THE PROPOSED FEE SCHEDULE FOR OTHER PROFESSIONS, SUCH AS MEDICAL DOCTORS, PHYSICAL AND OCCUPATIONAL THERAPISTS (WHO, LIKE DOCTORS OF CHIROPRACTIC, INCORPORATE THESE METHODS OF CARE ON A DAILY BASIS).

WITHOUT COVERAGE FOR THIS CARE, DOCTORS OF CHIROPRACTIC CANNOT DELIVER EFFECTIVE CARE TO INJURED WORKERS COVERED BY THE SYSTEM. IF NOT INCORPORATED, WE FEAR PATIENT SUFFERING INCREASED LOST TIME FROM WORK, ADDITIONAL TREATMENT/REFERRALS, AND DELAYS IN FUNCTIONAL GAINS WILL RESULT. EVEN GREATER IS THE FEAR THAT PATIENTS NOT EXPERIENCING APPROPRIATE RELIEF WILL UNNECESSARILY TURN TO MORE AGGRESSIVE AND EXPENSIVE METHODS OF PAIN CONTROL. NEW YORK ALREADY LEADS THE NATION WITH RESPECT TO NARCOTIC USE. WE CERTAINLY DO NOT WANT TO RISK FURTHER MISUSE.

FINALLY, IT IS VERY IMPORTANT TO REMEMBER THAT WHILE MEDICARE MAY NOT REIMBURSE FOR SOME OF THESE SERVICES, DOCTORS OF CHIROPRACTIC ARE ALLOWED TO RENDER ANY MEDICALLY NECESSARY SERVICE, AND THE PATIENT, OR A SECONDARY INSURER, HAS THE RESPONSIBILITY TO PAY FOR THEM. THIS ALLOWS COMPLETE AND APPROPRIATE PATIENT CARE TO OCCUR. AS I'M SURE YOU ARE AWARE, AN INJURED WORKER CANNOT PAY OUT OF POCKET FOR MEDICAL SERVICES NEEDED AS THE RESULT OF A WORK RELATED INJURY. THEREFORE, IF THE FEE SCHEDULE DOES NOT COVER A NECESSARY SERVICE, INAPPROPRIATE IMPEDIMENTS ARE CREATED TO DELAY OR DENY APPROPRIATE PATIENT CARE.

IT IS IMPORTANT TO NOTE THAT NYSCA HAS BEEN IN CONTINUED DISCUSSIONS WITH THE WORKERS COMPENSATION BOARD ON A VARIETY OF ISSUES OVER

THE PAST FEW YEARS. SPECIFICALLY, WE HAVE WORKED ON THE CREATION, ADOPTION AND IMPLEMENTATION OF THE MEDICAL TREATMENT GUIDELINES. WHILE WE STILL SEE ROOM FOR IMPROVEMENT IN THESE GUIDELINES, WE ACCEPT THAT THE GUIDELINES NOW GOVERN THE CARE OF INJURED WORKERS IN NEW YORK. AS THESE GUIDELINES FUNCTION AS THE STANDARD OF CARE FOR THE INJURED WORKER, OUR SECOND CONCERN IS THAT THE ADHERENCE TO THE GUIDELINES IS NOT PROPERLY INCORPORATED OR REFLECTED INTO THE PROPOSED FEE SCHEDULE FOR DOCTORS OF CHIROPRACTIC.

THERE ARE MANY INSTANCES WHERE SERVICES APPROPRIATE UNDER THE MEDICAL TREATMENT GUIDELINES ARE NOT BEING REIMBURSED UNDER THE PROPOSED FEE SCHEDULE. AS PREVIOUSLY REFERENCED, ACTIVE AND PASSIVE THERAPIES, WHICH ARE CLEARLY OUTLINED IN THE NYS WC MEDICAL TREATMENT GUIDELINES, HAVE LIMITED OR NO COVERAGE WHEN PROVIDED BY A DOCTOR OF CHIROPRACTIC ACCORDING TO THE PROPOSED FEE SCHEDULE. DIAGNOSTIC SERVICES SUCH AS ELECTRODIAGNOSIS ARE ALSO NOTICEABLY ABSENT FROM THE CHIROPRACTIC SECTION OF THE PROPOSED FEE SCHEDULE.

NYSCA, AND THE TREATING MEDICAL PROVIDERS WE REPRESENT, STRONGLY FEEL THAT ALL SERVICES RENDERED BY AN AUTHORIZED WORKERS COMPENSATION MEDICAL PROVIDER THAT ARE PROVIDED ACCORDING TO THE GUIDELINES SHOULD BE EQUIVOCALLY COMPENSATED. ANYTHING SHORT OF

THIS DETRACTS FROM THE INTENT AND POSITIVE IMPACT OF THE MEDICAL TREATMENT GUIDELINES.

NYSCA BELIEVES THAT FAILURE TO HAVE A FEE SCHEDULE CONSISTENT WITH THE GUIDELINES MAY LEAD TO DELAYS IN CARE, REFERRALS TO SEVERAL HEALTHCARE PROVIDERS, INCOMPLETE TREATMENT, UNNECESSARY CO-TREATMENT, AND WILL RESULT IN SUBSTANDARD PATIENT OUTCOMES. IN EFFECT, IT WOULD UNDERMINE THE INTENT OF THE MEDICAL TREATMENT GUIDELINES, TO THE DETRIMENT OF THE INJURED WORKER.

THE FINAL ISSUE THAT NYSCA HAS WITH THE PROPOSED FEE SCHEDULE IS ONE OF PARITY AND EQUALITY. IT IS IMPORTANT TO RECOGNIZE THAT THE FEE SCHEDULE UTILIZES COMMON PROCEDURAL TERMINOLOGY (CPT) CODING WHICH IS COMMON AND SHARED BY ALL PROFESSIONS. AS SUCH, ALL PROFESSIONS SERVING AS AUTHORIZED MEDICAL PROVIDERS WITHIN NYS WORKERS COMPENSATION SHOULD HAVE ACCESS TO THE COMPLETE FEE SCHEDULE AND BE PERMITTED TO BILL FOR ANY AND ALL CPT CODES THAT THEY RENDER TO AN INJURED WORKER, SO LONG AS IT IS DONE WITHIN THEIR SCOPE OF PRACTICE. THE NYSCA FEELS STRONGLY THAT ANY AUTHORIZED MEDICAL PROVIDER THAT IS PROVIDING SERVICES TO INJURED WORKERS COVERED WITHIN THEIR SCOPE OF PRACTICE MUST BE EQUITABLY AND FAIRLY REIMBURSED FOR THOSE SERVICES.

QUALIFIED PROVIDERS, OFFERING THE SAME SERVICE, WITH SIMILAR EQUIPMENT AND OVERHEAD SHOULD BE REIMBURSED SIMILARLY; ANYTHING ELSE DEFIES REASON AND WILL CREATE FURTHER DISTRUST WITHIN THE SYSTEM. THERE HAVE BEEN IMPROVEMENTS IN THIS AREA COMPARED TO THE PRIOR FEE SCHEDULE. HOWEVER, SOME AREAS CONTINUE TO LACK PARITY AND EVEN CODIFY DRAMATIC DIFFERENCES IN FEES FOR SIMILAR SERVICES. EXAMPLES INCLUDE COMPLETION OF MAXIMAL MEDICAL IMPROVEMENT EXAMINATIONS (WCB FORM C4.3) WHICH REQUIRES THE SAME EXAMINATION AND COMPLETION OF THE SAME FORM, BUT REIMBURSEMENT DIFFERS WIDELY. CHIROPRACTIC REIMBURSEMENT WILL BE BASED ON A LOW LEVEL EXAM CODE WITH THE ADDITION OF $100 (SECTION 4.2.2 FEE SCHEDULE DISCUSSION DOCUMENT), WHILE OTHER MEDICAL PROVIDERS WILL BE REIMBURSED USING A HIGHER VALUE EXAM CODE PLUS $200 (SECTION 4.2.1 FEE SCHEDULE DISCUSSION DOCUMENT). IT IS HARD TO COMPREHEND HOW EVALUATION TO DETERMINE A PATIENT'S FUNCTIONAL ABILITIES AND LIMITATIONS AND COMPLETION OF STANDARDIZED PAPERWORK TO DOCUMENT THOSE FINDINGS WOULD VARY IN VALUE SO GREATLY. SIMILAR DIFFERENCES IN FEES EXISTS FOR MEDICAL TESTIMONY AS OUTLINED IN SECTION 3.2.8, WITH INITIAL FEES, ADDITIONAL TESTIMONY FEES, AND DAILY MAXIMUMS BEING MARKEDLY DIFFERENT FOR CHIROPRACTORS COMPARED TO OTHER DOCTORAL LEVEL AUTHORIZED TREATING PROVIDERS.

FURTHER, LIMITATIONS IN DIAGNOSTIC SERVICES THAT HAVE BEEN IMPOSED BY THE WORKERS COMPENSATION BOARD MUST BE ELIMINATED. PROHIBITING SERVICES THAT ARE WITHIN A PROVIDERS SCOPE OF PRACTICE FOR NO JUSTIFIABLE REASON, SUCH AS THE LIMITATIONS PLACED ON ELECTRODIAGNOSIS, CAN LEAD TO DELAY IN PROPER DIAGNOSIS, DELAY IN APPROPRIATE CARE, INCREASED SUFFERING AND LOST TIME FOR THE INJURED WORKER. A DEGREE DOES NOT DECREE A LEVEL OF EXPERTISE IN PERFORMING OR EVALUATING A SPECIFIC, ADVANCED DIAGNOSTIC TEST SUCH AS ELECTRODIAGNOSIS. THE NYSCA HAS PREVIOUSLY SHARED WITH THE NYS WCB THE EXTENSIVE TRAINING NECESSARY FOR A DOCTOR OF CHIROPRACTIC TO BECOME CERTIFIED IN SUCH TESTING, WHICH IS EQUAL TO, OR EXCEEDS, THAT OF A MEDICAL DOCTOR.

TREATING LIKE PROVIDERS DIFFERENTLY FOR THE PROVISION OF LIKE SERVICES WILL HAVE A NEGATIVE IMPACT ON AN INJURED WORKER'S RIGHT TO CHOOSE THEIR PROVIDER AND THE WORKER'S ACCESS TO HEALTHCARE SERVICES ONCE THEY HAVE CHOSEN THEIR PROVIDER. WE MUST REMAIN MINDFUL THAT OUR COLLECTIVE GOAL IS TO SERVE THE INJURED WORKERS WITH NOT ONLY COST-EFFECTIVE, BUT HIGH QUALITY AND EFFICIENT DELIVERY OF HEALTHCARE SERVICES.

WE HAVE CONCERN THAT MISTAKES OF YESTERYEAR WILL BE REPEATED IN THE UPDATE OF THE NYS WC MEDICAL TREATMENT SCHEDULE. REGRETFULLY,

CONSERVATIVE CARE (INCLUDING CHIROPRACTIC CARE) IS SOMETIMES INCORRECTLY VIEWED AS AN 'ADD-ON' SERVICE THAT INFLATES THE COST OF HEALTHCARE DELIVERY. THIS VIEW AND THIS METHOD OF COST-SAVINGS HAS PROVEN TO BE NOT ONLY INCORRECT, BUT ALSO INEFFECTIVE IN THE MAJOR MEDICAL ARENA. CONTEMPORARY METHODOLOGY THAT ACKNOWLEDGES THE TRUE COST DRIVERS IN THE SYSTEM (EXPENSIVE AND OVERUTILIZED TESTS AND PROCEDURES) AND RIGHTFULLY PLACES CONSERVATIVE CARE AS THE FOCUS OF MUSCULOSKELETAL CARE HAS SHOWN PROMISE IN REDUCING CHRONICITY, EXPEDITING RETURN TO WORK, REDUCING NEED FOR SURGERY AND ADVANCED IMAGING, REDUCED DISABILITY AND CONTROLLING COSTS. (SEE APPENDICES 1-5). THIS MUST BE THE METHOD WE ADOPT IN NEW YORK AS WE MODERNIZE OUR WORKERS COMPENSATION SYSTEM.

ON BEHALF OF ALL THE MEMBERS OF THE NEW YORK STATE CHIROPRACTIC ASSOCIATION, I THANK YOU FOR YOUR LEADERSHIP ON THIS ISSUE AND HOPE THAT YOU CAN HELP TO ENSURE THAT THE WORKERS COMPENSATION BOARD ADOPTS AND IMPLEMENTS A FEE SCHEDULE THAT FAIRLY COMPENSATES AN AUTHORIZED TREATING PROVIDER FOR THE SERVICES RENDERED AND THUS ENSURE THAT INJURED WORKERS IN NEW YORK STATE CONTINUE TO RECEIVE APPROPRIATE AND NECESSARY HEALTH CARE FROM THE PROVIDER OF THEIR CHOICE.

APPENDIX 1

POPULATION HEALTH MANAGEMENT
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Original Article

Conservative Spine Care: Opportunities to Improve the Quality and Value of Care

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Abstract

Low back pain (LBP) has received considerable attention from researchers and health care systems because of its substantial personal, social, work-related, and economic consequences. A narrative review was conducted summarizing data about the epidemiology, care seeking, and utilization patterns for LBP in the adult US population. Recommendations from a consensus of clinical practice guidelines were compared to findings about the current state of clinical practice for LBP. The impact of the *first provider consulted* on the quality and value of care was analyzed longitudinally across the continuum of episodes of care. The review concludes with a description of recently published evidence that has demonstrated that favorable health and economic outcomes can be achieved by incorporating evidence-informed decision criteria and guidance about entry into conservative low back care pathways. (*Population Health Management* 2013;16:xxx–xxx)

Introduction

The United States has the most expensive and complex health care system in the world,[1] yet the magnitude of funds spent on the system has failed to provide commensurate benefits in terms of quality, access, and cost performance.[2]

To achieve value for the current levels of investment in care, the factors that contribute to variation in costs and quality must be addressed. In fact, experts have concluded that the quality and efficiency of the US health care system could be improved by approaches that address overuse, and inappropriate or ineffective use of care—the chief factors contributing to the current high levels of expenditures, inefficiency, and waste.[3]

A previous article analyzed current practices regarding the use of coronary stents in the chronic stable angina patient.[4] Musculoskeletal disorders represent another diagnostic class that, while usually not life threatening, results in a high prevalence of morbidity and significant societal burden.[5] Low back pain (LBP) management in particular has been linked to inefficiency and waste.[6] This is likely related, in part, to the growing list of treatment approaches recommended for conservative care (pharmacologic and nonpharmaceutical options) and the difficulty in determining the best option for each patient.[7]

Although useful in assisting practitioner and patient decisions about appropriate health care for specific clinical circumstances,[8] clinical practice guidelines (CPGs) are not sufficient to maximize effectiveness and cost-effectiveness at the individual level (ie, targeting specific care).[9] The clinical appropriateness of health care services at the individual level can be assessed by considering the patient's clinical characteristics, the relevant risk factors, the setting or health care provider type, the severity of the illness, and the specific requirements for a procedure (eg, availability of the service).[9]

The purpose of this article is to discuss the challenges associated with management of LBP and describe an evidence-informed process to effectively and cost-effectively integrate individual patient conservative care for LBP with appropriate population-based recommendations found in high-quality CPGs.

Back Pain—An Overview

Pain affects millions of Americans; contributes greatly to national rates of morbidity, mortality, and disability; and is rising in prevalence.[10] Back pain is the most common

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physical condition for which patients visit their doctor,[6] and surveys reveal that over one quarter of adults (26%) report LBP in the past 3 months.[11] The lifetime prevalence of LBP is approximately 85% (probably closer to 100% of adults).[12]

A substantial majority of those who suddenly develop LBP improve quickly with or without professional care. However, recurrences and flare-ups are common, and individuals with chronic LBP tend to show a more persistent course.[13] Thus, LBP is best viewed as a recurrent disorder that can occur anytime in a person's life and fluctuates between no/mild pain to debilitating pain.[12] Important prognostic factors are related to the back pain episode, individual and psychological characteristics, as well as the work and social environment.[13]

About 1 in 2 people who experience LBP seek health care during an episode.[14] Care seekers tend to be those who have high levels of disability,[15] and/or who are experiencing more severe pain, more distal pain, work-related pain, and those who are more fearful about what the pain might mean.[14] Clinicians most commonly consulted for back pain in North America are chiropractors, general medical practitioners, and orthopedists.[14] When initial care seeking is calculated on an episodic basis, chiropractors and primary care physicians (PCPs) are by far the provider types most commonly consulted (D. Elton, unpublished data, 2010) (Figure 1). About 85% to 90% of individuals who seek care are assessed as having nonspecific or ordinary LBP (ie, not associated with a specific cause including serious pathology).[16]

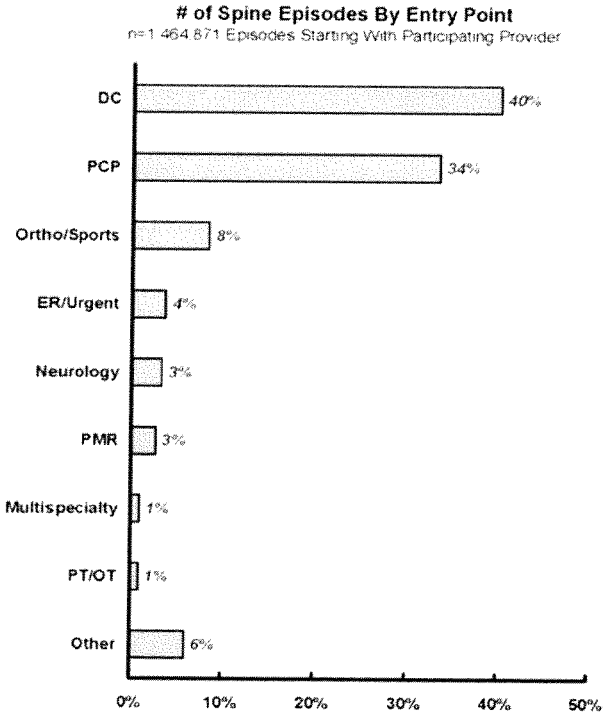

FIG. 1. Number of spine episodes by entry point. Source: Elton D., et al. OptumHealth Episode Treatment Group Analysis, 2010. DC, Doctor of Chiropractic; PCP, primary care physician; ER, emergency room; PMR, physical medicine and rehabilitation specialist; PT/OT, physical therapist/occupational therapist.

Increasingly, back pain has become a financial concern because of the high associated direct and indirect costs of testing and treatment. Cost estimates vary, but the most recent estimates (2008) put care related to back pain at $86 billion in incremental health care costs.[17] A 49% increase in the number of patients seeking spine-related care (from 12.2 million in 1997 to 18.2 million in 2006) was the largest contributing factor to increased outpatient expenditures.[18] Adding to the problem is a sharp increase in the number of investigations and interventions performed related to back pain, including imaging, injections, surgical procedures, implantable devices, and medications. These services have value for some patients, but it appears that they are being used in areas beyond those for which data support an improvement in outcomes.[19]

Despite the fact that the proportion of office visits has changed little since 1990, there has been remarkable (307%) growth in the use of lumbar magnetic resonance imaging (MRI) in the Medicare population from 1994 to 2004.[21] Using current guidelines as a baseline, one third to two thirds of spinal computed tomography (CT) imaging and MRI may be inappropriate.[19]

Use of opioid prescriptions also has increased by 108% from 1997 to 2004 resulting in a 423% inflation-adjusted increase in expenditures.[19] The number of spinal injections grew more than 200% over the same time period, and spine surgery rates have risen over 200% from 1997–2004. Spine imaging rates vary across geographic regions, and the rate of surgery is highest where imaging rates are highest. Moreover, the evidence shows that despite newer technologies, higher spine surgery rates can be associated with worse outcomes.[19]

The Challenge of Low Back Pain

Patient "care-seeking" decisions for LBP initiate a cascade of management services and processes representing clinical pathways that may or may not equate to the most appropriate intervention for individuals.[20] Treatment choices can be influenced by patients depending on the types of health care providers they choose to consult, which in turn influences the types of treatments received.[21] In many instances, circumstances require that patients navigate LBP management on their own.[22] Fundamental challenges include:

- *Provider Type*—People who develop LBP and wish to seek care are first required to select a health provider. To a large degree, the tests and services provided to individuals are dependent upon the health care professional type from whom a patient first seeks care.[21,23] More than 20 different health care provider types (eg, physicians, allied health, complementary and alternative medicine) may be considered when seeking treatment for LBP.[7]
- *Treatment Options*—The challenge of weighing alternate treatment options for LBP does not end once the choice of a specific type of health provider is made. A partial list of treatment options available to a person with LBP includes more than 200 different medications, therapies, injections, products, or procedures.[7] It is difficult for any health care provider involved in the management of LBP to understand the relative benefits and harms of each intervention at a level that is sufficient to advise his or her patients.

- *Individual Patient Variations*—The selection of the correct intervention for LBP is further complicated by differences in baseline prognoses among patients seeking care.[24] An important consideration when commencing an episode of care is the "targeting" of interventions that address individual risk factors.[25]

Review of Clinical Practice Guidelines for Low Back Pain

A number of CPGs have been published recently that focus on the management of acute and/or persistent (chronic) common (nonspecific) LBP.[26–35] Typically, these guidelines commence with patient decisions to enter primary care management. They describe recommendations for diagnostic assessment, treatment options (eg, self-care, pharmacotherapy, non-pharmacologic interventions), and indications for referral for testing and specialist care.

Synthesized recommendations from these CPGs provide a consistent set of "quality" recommendations concerning processes of care.[36,37,38] Specifically, 10 CPGs sponsored by 10 different international organizations during the past decade were compared and summarized in a recent text.[13] Both acute and chronic LBP complaints were represented, providing an overview of the best available evidence to inform clinical judgment. Although each new CPG may emphasize a distinct aspect of care or a specific subgroup, the collective recommendations have been largely consistent, with only minor changes throughout the years based on new evidence. [17,30]

Among these guidance documents, there was general agreement on 5 main sequential goals when conducting an assessment of LBP:

1. Ruling out potential serious pathology (eg, infection).
2. Ruling out specific causes of LBP (eg, spinal stenosis).
3. Ruling out substantial neurological involvement.
4. Evaluating the severity of symptoms and functional limitations.
5. Identifying risk factors for chronicity.[13]

For the 85%–90% of individuals assessed as having nonspecific or ordinary LBP, CPGs recommend against routine imaging (eg, radiography, CT scan, MRI), stronger opioid analgesics, and injection procedures (eg, epidural, facet, soft tissue). Instead, the consensus of the guidelines suggests that patients with acute, nonspecific LBP should:

- be reassured of a good prognosis,
- be educated in self-care,
- remain active,
- use over-the-counter medications (eg, acetaminophen, nonsteroidal anti-inflammatory drugs) or spinal manipulation or both as a first line of symptom control.[30]

Other physical modalities (eg, traction, ultrasound, transcutaneous electrical nerve stimulation) and supports/braces are not recommended by CPG developers. Supervised exercise and, to a lesser degree, behavioral modification and/or acupuncture therapies also are recommended for individuals who have chronic or persistent LBP.[38]

In summary, the goal of CPGs is to provide algorithms whereby busy clinicians can quickly determine/identify "best practice" alternatives for their patients that are based on careful evaluation of the evidence.[39] Ideally, CPGs focus on common problems with significant morbidity or mortality. Back pain fits this ideal. Whether CPGs are worth the resources that continue to be dedicated to them remains a matter of speculation.[40]

Current Clinical Practices

When followed by providers and patients, evidence-based guidelines for the clinical management of LBP have been associated with better functional outcomes, reduced health care utilization, and lower health care costs.[41,42] Yet there is a strong body of evidence suggesting a low level of adherence to guidelines in daily clinical practice.[43,44] Overall adherence to guideline-based care by PCPs has been recorded at 65%, a rate that has remained unchanged despite attempts to increase implementation of evidence-based care.[43] For acute nonspecific LBP, 65% of the cases receive recommendations for imaging studies despite clear guidance that this is not routinely indicated.[45] Only half of LBP patients who see a PCP receive a recommendation to remain active.[45] Manipulation, which is supported by most guidelines, is recommended by PCPs in only 2% of the acute nonspecific LBP cases. This gap in adherence to evidence-based practice recommendations by clinicians has become popularly known as the "know-do gap"—the gap between what is known and what is done in practice.[46,47]

These national trends are contextualized by data that describe the *timing* of services received by patients seeking care for spinal pain in the "real world" of clinical practice. A recently published analysis of nationwide private insurer claims covering more than 8 million lives revealed the front-loading of treatment expenditures, even among patients with nonspecific LBP.[17] "Contrary to clinical guidelines, many patients with low back pain start incurring significant resource use and associated expenses soon after the index [initial] diagnosis." [17, p.623] The analysis showed:

- Diagnostic and treatment interventions were common in the first month.
- More than 32% of patients with LBP received X-rays, with at least 50% receiving them on the same day as the initial diagnosis.
- Second-line medication was prescribed for 69.4% of patients, with at least 50% of those patients filling the prescription within 8 days of the initial diagnosis.
- Opioids were prescribed for 41.6% of patients, and more than half of the prescriptions were filled within 25 days of the initial visit.
- The median number of days to surgery was 90 for all those having surgery. Surgery was performed within 54 days (median) of the initial diagnosis for those individuals not classified as having chronic LBP (>3 months duration).

The impact of nonadherence to evidence-based CPGs has been measured by analyzing *episodes of care*—a method that provides longitudinal data across the entire pathway of care (eg, total number of health care providers seen by the individual throughout the episode of care, the diagnostic tests performed, the medication prescribed).[48] As demonstrated by data synthesized by Elton (Figure 1), individuals with similar risk profiles who begin their care pathway with a chiropractor or PCP see fewer total health care providers throughout the overall episode of care than do individuals

who initially consult an orthopedic specialist, physical medicine/rehabilitation specialist, or physical/occupational therapist (Table 1). Individuals who commence an episode of care with a chiropractor or PCP are less likely to undergo imaging and are prescribed fewer medications. Also, they are more likely to receive first-line management options as recommended by CPGs.

These findings are similar to recently published data. A 2-year retrospective claims analysis of BlueCross BlueShield TN members presenting with LBP employed a similar episode treatment grouping methodology. "Paid costs for episodes of care initiated with a DC [chiropractor] were almost 40% less than episodes initiated with an MD [physician]. Even after risk adjusting each patient's costs, we found that episodes of care initiated with a DC were 20% less expensive than episodes initiated with an MD."[49]

The current management of back pain has led to increased resource usage without a corresponding improvement in outcomes. In a nationally representative population sample (Medical Expenditure Panel Survey), trends in health care expenditures from 1997 to 2005 were calculated for adults who self-reported spine problems (neck pain and LBP).[50] Spine-related expenditures were found to have increased substantially from 1997 to 2005 without evidence of corresponding improvement in self-assessed health status, functional disability, work limitations, or social functioning.

These findings about the current state of clinical practice for spine-related disorders provide substance to the assertion that we need to rethink frontline care for back pain.[23]

Patient-Centered Conservative Care

Decision criteria and guidance about entry into conservative LBP care pathways represent an opportunity to advance the quality and delivery of health services. The choice of initial health care provider matters when it comes to spine-related disorders. The variable impact of "first provider seen" is greatest for the 85%–90% of health care consulters who have "nonspecific" spine-related pain.[24] For these patients, guidelines highlight the importance of assessing a broad range of potential influences on prognosis including fears and anxieties about pain, physical limitations related to pain, mood, motivation, and work situation.[29,32,35]

Previous authors have postulated that targeting specific back pain interventions for particular subgroups of patients holds great potential for boosting their effectiveness.[51,52] "However, this is often difficult to do in practice and, until recently, no validated tool has existed to inform clinicians or others about the risk status of individual patients."[53] The STarT Back Screening Tool (SBST), developed by researchers at Keele University (United Kingdom) with funding from Arthritis Research UK, can be administered *prior to* initiating treatment. This tool presents an opportunity to fill a serious knowledge gap in the delivery of health services by incorporating evidence-informed decision criteria and guidance about entry into conservative low back care pathways (Figure 2).

This *classification-based* model for the management of LBP has been shown to improve clinical outcomes and address the inappropriate utilization of services.[25] It is predicated on the understanding that not all patients entering a care pathway for nonspecific LBP are the same. Primary care data suggest that, for first contact settings such as general practitioner consultations, approximately 55% of patients with nonspecific LBP are at low risk of poor outcome (ie, patients who are likely to do well irrespective of treatment); 33% are at medium risk; and 12% are at high risk.[24]

Appropriate individualized care management may be facilitated when the first health care provider seen is best equipped to administer the treatment most likely to benefit a particular patient.[23] Using the SBST approach, individuals at "low risk" usually benefit most from receiving reassurance and advice, which can be rendered by PCPs, nurses, or health coaches (Table 2). The treatment options recommended for persons at "medium risk"—manual therapy (eg, manipulation) and specific exercises—are most typically provided by chiropractors and physical therapists. Optimally, the management of patients at "high risk" should be overseen by physical therapists or chiropractors, who are skilled in providing behavioral therapy in addition to the same strategies targeted for patients at medium risk.[54]

This framework has demonstrated "proof of principle" in a recently published clinical trial.[25] "The results showed the SBST approach changes the pattern of management and referral in a way that is more appropriate for patients' needs."[53] When compared to current best practice, use of the SBST tool

TABLE 1. EPISODE EXPERIENCE

Specialty	*Age (yrs)*	*Female (%)*	*Risk*	*Duration (days)*	*Providers (total/episode)*	*Surgery (%)*	*Radiology (%)*	*Pharma (%)*
Chiropractor	40	55	1.8	102	1.6	0	25	14
PCP	42	56	2.0	61	2.1	0	37	37
Ortho/Sports	41	56	2.5	81	2.6	0	80	31
ER/Urgent Care	37	55	2.1	51	3.2	0	47	33
Neurology	47	58	3.5	114	3.3	0	60	38
PM&R	45	57	2.9	120	3.0	0	59	40
Multispecialty	42	57	2.4	76	2.8	0	48	33
PT/OT	45	63	2.9	152	4.1	0	54	43
Other	32	58	2.2	69	2.4	0	40	24
Average	**41**	**56**	**2.1**	**84**	**2.1**	**0**	**38**	**26**

PCP, primary care physician; Ortho = orthopedist; ER, emergency room; PM&R, physical medicine and rehabilitation specialist; PT, physical therapist; OT, occupational therapist.

Thinking about the **last 2 weeks** tick your response to the following questions:

		Disagree	Agree
		0	1
1	My back pain has **spread down my leg(s)** at some time in the last 2 weeks	☐	☐
2	I have had pain in the **shoulder** or **neck** at some time in the last 2 weeks	☐	☐
3	I have only **walked short distances** because of my back pain	☐	☐
4	In the last 2 weeks, I have **dressed more slowly** than usual because of back pain	☐	☐
5	It's not really safe for a person with a condition like mine to be physically active	☐	☐
6	**Worrying thoughts** have been going through my mind a lot of the time	☐	☐
7	I feel that **my back pain is terrible** and **it's never going to get any better**	☐	☐
8	In general I have **not enjoyed** all the things I used to enjoy	☐	☐

9. Overall, how **bothersome** has your back pain been in the **last 2 weeks**?

Not at all	Slightly	Moderately	Very much	Extremely
☐	☐	☐	☐	☐
0	0	0	1	1

Funded by Arthritis Research UK

FIG. 2. The STarT Back Screening Tool.

along with targeted treatments increased efficiency, improved clinical outcomes, and reduced health care costs.

Almost half of the "low-risk" patients in the usual care group, who typically respond well to self-care management, were referred for supervised physical therapy. In contrast, more than 90% of those allocated to the SBST group were provided with advice and education to support self-care management. Conversely, more than a third of patients likely to benefit from supervised therapy (medium- and high-risk categories) in the usual care group did not receive referrals. Virtually all those patients in the SBST group, who were similarly categorized, were referred for therapy.

Overall, 75% of the SBST group were referred for physical therapy vs. 60% of controls. Despite this greater rate of referral, the costs over 12 months were about 13% less for the SBST group. Savings were attributed in large part to more efficient utilization. The SBST referral group averaged 4.2 visits, while the usual care group received a mean of 5.1 visits.

At 4 and 12 months, the SBST group demonstrated superior patient-important outcomes compared to the "usual care" control group at both 4 and 12 months. Adjusted mean changes in disability scores were significantly better in the SBST group than in the control group at 4 months and at 12 months. The patients in the SBST group were significantly more likely to be satisfied with treatment and lost fewer days of work. Importantly, those individuals in the low-risk category who did not receive referral for therapy did as well or slightly better than those in the same risk category who did receive a course of physical therapy.

TABLE 2. SBST CLASSIFICATION OF BACK PAIN

Categories	*Prognosis/Characteristics*	*Approach*
Low risk *(55%)*	**Low risk of chronicity** • Favorable prognosis • Able to maintain most usual daily activities • Can manage pain pretty well on their own	• Reassurance • Self-management • Advice sheet • 5 minute DVD
Medium risk *(35%)*	**Physical obstacles to recovery** • Less favorable prognosis/moderate risk of chronicity • Likely experiencing noticeable challenges in ADLs • Optimal recovery achieved using treatments that control pain and/or target physical limitations (manipulation, exercise, OTC)	• Low risk treatment AND • Exercises • Manual therapy • RTW advice • Medication compliance
High risk *(10%)*	**Psychological obstacles to recovery** • Unfavorable prognosis for normal recovery • Combination of physical challenges and negative psychological response • Treatments target combination of physical and behavioral approaches	• Medium risk treatment AND • CBT approach to reduce disability and pain, improve psychological functioning (coping skills) to manage ongoing/future episodes

Hill J, DGT Whitehurst, Lewis M, et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): a randomised controlled trial. *Lancet* 2011;378:1560–1571.

ADLs, activities of daily living; OTC, over-the-counter medication; RTW, return to work; CBT, cognitive behavioral therapy; SBST, STarT Back Screening Tool.

Conclusion

The current state of the conservative management of LBP is summarized in this narrative review. Current clinical practice has been ineffective in meeting the challenge of consistently adhering to the recommendations of modern evidence-based guidelines. It is not surprising that patient "care-seeking" decisions for LBP initiate a cascade of interventions that may or may not represent the most appropriate management for individuals.

One opportunity to facilitate compliance with clinical guidelines is to assure that the first health care provider seen is best able to administer the treatment likely to benefit a particular patient. This can be achieved, in part, by implementing a triage approach for the early referral of well-defined subgroups of patients into appropriate clinical pathways. Recently published evidence supports this premise. The STarT Back subgrouping and targeted treatment approach has been shown to significantly improve patient outcomes (*effectiveness*) and is associated with substantial economic benefits (*efficiency*) compared with current usual practice.[24]

Author Disclosure Statement

Drs. Kosloff, Elton, and Shulman are employees of Optum Health Care Solutions. Optum Health Care Solutions is currently contracted with the Jefferson School of Population Health to develop programs around overutilization in health care. Ms. Clarke, Dr. Skoufalos, and Ms. Solis are employees of the Jefferson School of Population Health, which has been contracted to collaborate with Optum Health Care Solutions on programs regarding health care overutilization.

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References

1. Sarpel U, Vladeck BC, Divino CM, Klotman PE. Fact and fiction: Debunking myths in the US healthcare system. Ann Surg. 2008;247(4):563–569.
2. Institute of Medicine. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academies Press; 2001.
3. Davis K, Schoen C, Guterman S, Shih T, Schoenbaum SC, Weinbaum I. Slowing the growth of U.S. health care expenditures: What are the options? Available at: <http://www.commonwealthfund.org/Publications/Fund-Reports/2007/Jan/Slowing-the-Growth-of-U-S-Health-Care-Expenditures-What-Are-the-Options.aspx>. Accessed October 11, 2012.
4. Behnke LM, Solis A, Shulman SA, Skoufalos A. A targeted approach to reducing overutilization: Use of percutaneous coronary intervention in stable coronary artery disease. Popul Health Manag. Epub ahead of print October 31, 2012.
5. Woolf AD, Erwin J, March L. The need to address the burden of musculoskeletal conditions. Best Pract Res Clin Rheumatol. 2012;26:183–224.
6. American Academy of Orthopaedic Surgeons. Spine: Low back and neck pain. In: The Burden of Musculoskeletal Diseases in the United States. Available at: <http://www.boneandjointburden.org/pdfs/BMUS_chpt2_spine.pdf>. Accessed October 11, 2012.
7. Haldeman S, Dagenais S. A supermarket approach to the evidence-informed management of chronic low back pain. Spine J. 2008;8:1–7.
8. Field MJ, Lohr KN, eds. Clinical Practice Guidelines: Directions for a New Program. Washington, DC: National Academy Press; 1990;38.
9. Lavis JN, Anderson GM. Appropriateness in health care delivery: Definitions, measurement and policy implications. CMAJ. 1996;154:321–328.
10. Schiller JS, Lucas JW, Ward BW, Peregoy JA. Summary health statistics for U.S. adults: National Health Interview Survey, 2010. Vital Health Stat 10. 2012;10(252):1–207.
11. Paulose R, Hertz RP. The burden of pain among adults in the United States. Available at: <http://www.pfizer.com/files/products/PF_Pain.pdf>. Accessed October 11, 2012.
12. Dagenais S, Haldeman S. Evidence-Based Management of Low Back Pain. St Louis, MO: Mosby, Inc. (Elsevier); 2012: 1–2.
13. Hayden JA, Dunn KM, van der Windt DA, Shaw WS. What is the prognosis of back pain? Best Pract Res Clin Rheumatol. 2010;24:167–179.
14. Kent PM, Keating JL. The epidemiology of low back pain in primary care. Chiropr Osteopat. 2005;13:13.
15. Ferreira ML, Machado G, Latimer J, Maher C, Ferreira PH, Smeets RJ. Factors defining care-seeking in low back pain—a meta-analysis of population based surveys. Eur J Pain. 2010;14:747.e1–7.
16. Deyo RA, Weinstein JN. Low back pain. N Engl J Med. 2001;344:363–370.
17. Ivanova JI, Birnbaum HG, Schiller M, Kantor E, Johnstone BM, Swindle RW. Real-world practice patterns, health-care utilization, and costs in patients with low back pain: the long road to guideline-concordant care. Spine J. 2011;11:622–632.
18. Martin BI, Turner JA, Mirza SK, Lee MJ, Comstock BA, Deyo RA. Trends in health care expenditures, utilization, and health status among US adults with spine problems, 1997–2006. Spine (Phila Pa 1976). 2009;34:2077–2084.
19. Deyo RA, Mirza SK, Turner JA, Martin BI. Overtreating chronic back pain: Time to back off? J Am Board Fam Med. 2009;22:62–68.
20. Fourney DR, Dettori JR, Hall H, Härtl R, McGrit MJ, Daubs MD. A systematic review of clinical pathways for lower back pain and introduction of the Saskatchewan spine pathway. Spine (Phila Pa 1976). 2011;36(21 suppl):S164–S171.
21. Carey TS, Freburger JK, Holmes GM, et al. A long way to go: Practice patterns and evidence in chronic low back pain care. Spine (Phila Pa 1976). 2009;34:718–724.
22. Weisel SW, ed. Has there been any progress in the management of low back pain? The BackLetter. 2011;26:109–116.
23. Hartvigsen J, Foster N, Croft PR. We need to rethink front line care for back pain. BMJ. 2011;342:d3260.
24. Hill JC, Dunn KM, Lewis M, et al. A primary care back pain screening tool: Identifying patient subgroups for initial treatment. Arthritis Rheum. 2008;59:632–641.
25. Hill JC, Whitehurst DGT, Lewis M, et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): A randomised controlled trial. Lancet. 2011;378(9802):1560–1571.
26. Accident Compensation Corporation, New Zealand Guidelines Group. New Zealand Acute Low Back Pain Guide. Wellington, NZ: Accident Compensation Corporation (ACC); 2004.
27. Airaksinen O, Brox JL, Cedraschi C, et al. European guidelines for the management of chronic nonspecific low back pain in primary care. COST B13 Working Group on Guidelines for Chronic Low Back Pain, European Commission, 2005.

28. Australian Acute Musculoskeletal Pain Guidelines Group. Evidence-Based Management of Acute Musculoskeletal Pain. Brisbane, Australia: Australian Academic Press Pty. Ltd.; 2003.
29. Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: A joint clinical practice guideline from the American College of Physicians and the American Pain society. Ann Intern Med. 2007;147:478–491.
30. Negrini S, Giovannoni S, Minozzi S, et al. Diagnostic therapeutic flow-charts for low back pain patients: The Italian clinical guidelines. Eura Medicophys. 2006;42:151–170.
31. Nielens H, Van Zundert J, Mairiaux P, et al. Chronic Low Back Pain. Report No. 48C. Brussels, Belgium: Belgian Health Care Knowledge Centre (KCE); 2006.
32. Savingy P, Kuntze S, Watson P, et al. Low back pain: Early management of persistent non-specific low back pain. Available at: <http://www.nice.org.uk/nicemedia/live/11887/44334/44334.pdf>. Accessed October 11, 2012.
33. The Norwegian Back Pain Network. Acute Low Back Pain: Interdisciplinary Clinical Guidelines. Oslo, UK: The Norwegian Back Pain Network; 2002.
34. Toward Optimized Practice. Guideline for the evidence-informed primary care management of low back pain. Available at: <http://nationalpaincentre.mcmaster.ca/documents/LowBackPainGuideline.pdf>. Accessed October 11, 2012.
35. van Tulder MW, Becker A, Bekkering T, et al. Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care. Eur Spine J 2006; 15(suppl 2):S169–S191.
36. Dagenais S, Tricco AC, Haldeman S. Synthesis of recommendations for the assessment and management of low back pain from recent clinical practice guidelines. Spine J. 2010; 10:514–529.
37. Koes BW, van Tulder M, Lin CW, Macedo LG, McAuley J, Maher C. An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. Eur Spine J. 2010;19:2075–2094.
38. Pillastrini P, Gardenghi I, Bonetti F, et al. An updated overview of clinical guidelines for chronic low back pain management in primary care. Joint Bone Spine 2012;70(2):176–185.
39. Hayward RS, Wilson MC, Tunis SR, Bass EB, Guyatt G. Users' guides to the medical literature. VIII: How to use clinical practice guidelines. A. Are the recommendations valid? The Evidence-Based Medicine Working Group. JAMA. 1995;274:570–574.
40. Jackson JL, Browning R. Impact of national low back pain guidelines on clinical practice. South Med J. 2005;98:139–143.
41. Feuerstein M, Hartzell M, Rogers HL, Marcus SC. Evidence-based practice for acute low back pain in primary care: Patient outcomes and cost of care. Pain. 2006;124(1–2):140–149.
42. Fritz JM, Cleland JA, Brennan GP. Does adherence to the guideline recommendation for active treatments improve the quality of care for patients with acute low back pain delivered by physical therapists? Med Care. 2007;45:973–980.
43. Finestone AS, Raveh A, Mirovsky Y, Lahad A, Milgrom C. Orthopaedists' and family practitioners' knowledge of simple low back pain management. Spine (Phila Pa 1976). 2009;34:1600–1603.
44. Williams CM, Maher CG, Hancock MJ, et al. Low back pain and best practice care: A survey of general practice physicians. Arch Intern Med. 2010;170:271–277.
45. Weiner SS, Weiser SR, Carragee EJ, Nordin M. Managing nonspecific low back pain: do nonclinical patient characteristics matter? Spine (Phila Pa 1976). 2011;36:1987–1994.
46. Pablos-Mendez A, Shademani R. Knowledge translation in global health. J Contin Educ Health Prof. 2006;26:81–86.
47. Scott NA, Moga C, Harstall C. Managing low back pain in the primary care setting: The know-do gap. Pain Res Manag. 2010;15:392–400.
48. Hornbrook MC, Hurtado A, Johnson RE. Health care episodes: Definition, measurement, and use. Med Care Rev. 1985;42:163–218.
49. Liliedahl RL, Finch MD, Axene DV, Goertz CM. Cost of care for common back pain conditions initiated with chiropractic doctor vs. medical doctor/doctor of osteopathy as first physician experience of one Tennessee-based general health insurer. J Manipulative Physiol Ther. 2010;33:640–643.
50. Martin BI, Deyo RA, Mirza SK, et al. Expenditures and health status among adults with back and neck problems. JAMA. 2008;299:656–664.
51. Fritz JM, Cleland JA, Childs JD. Subgrouping patients with low back pain: evolution of a classification approach to physical therapy. J Orthop Sports Phys Ther. 2007;37(6):290–302.
52. Waddell G. Subgroups within "nonspecific" low back pain. J Rheumatol. 2005;32:395–396.
53. Overview of the STarT Back approach. Available at: <http://www.keele.ac.uk/media/keeleuniversity/ri/primarycare/startbackmicro/Supporting%20statement.pdf>. Accessed October 11, 2012.
54. Sowden G, Hill JC, Konstantinou K, et al. Targeted treatment in primary care for low back pain: the treatment system and clinical training programmes used in the IMPaCT Back study (ISRCTN 55174281). Fam Pract. 2012;29:50–62.

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APPENDIX 2

COST OF CARE FOR COMMON BACK PAIN CONDITIONS INITIATED WITH CHIROPRACTIC DOCTOR VS MEDICAL DOCTOR/DOCTOR OF OSTEOPATHY AS FIRST PHYSICIAN: EXPERIENCE OF ONE TENNESSEE-BASED GENERAL HEALTH INSURER

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ABSTRACT

Objective: The primary aim of this study was to determine if there are differences in the cost of low back pain care when a patient is able to choose a course of treatment with a medical doctor (MD) versus a doctor of chiropractic (DC), given that his/her insurance provides equal access to both provider types.

Methods: A retrospective claims analysis was performed on Blue Cross Blue Shield of Tennessee's intermediate and large group fully insured population between October 1, 2004 and September 30, 2006. The insured study population had open access to MDs and DCs through self-referral without any limit to the number of visits or differences in co-pays to these 2 provider types. Our analysis was based on episodes of care for low back pain. An episode was defined as all reimbursed care delivered between the first and the last encounter with a health care provider for low back pain. A 60 day window without an encounter was treated as a new episode. We compared paid claims and risk adjusted costs between episodes of care initiated with an MD with those initiated with a DC.

Results: Paid costs for episodes of care initiated with a DC were almost 40% less than episodes initiated with an MD. Even after risk adjusting each patient's costs, we found that episodes of care initiated with a DC were 20% less expensive than episodes initiated with an MD.

Conclusions: Beneficiaries in our sampling frame had lower overall episode costs for treatment of low back pain if they initiated care with a DC, when compared to those who initiated care with an MD. (J Manipulative Physiol Ther 2010;33:640-643)

Key Indexing Terms: *Chiropractic; Medicine; Costs and Cost Analysis*

Low back pain (LBP) is well recognized as a significant public health problem. It has been estimated that 70% to 85% of Americans have back pain at some point in their lives.[1] Indeed, back pain is well established as one of the most common reasons for going to see a physician.[2,3] On the basis of the 2002 National Health Interview Survey, Deyo et al[4] report that about a quarter of the adult population reports LBP in any 3-month period and that LBP accounts for 2.3% of all physician visits. Druss and his colleagues[5] noted that back problems are one of the top 10 most costly conditions treated in the United States. According to the National Institute of Neurological Disorders and Stroke at National Institutes of Health, LBP treatment costs more than $50 billion per year. In addition, indirect costs for LBP have been estimated at between $7.4 billion and $19.8 billion per year, and the incremental medical care cost for LBP are estimated to be an additional $26 billion per year.[6,7]

Carey et al[8] recently conducted a survey to determine health care use patterns in patients with chronic LBP. They

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found high health care use in this group, with an average of 21 visits annually to an average of 2.7 provider types per year. Many of the tests and treatments used were not in line with evidence-based practice. The authors conclude that (1) care use for chronic LBP is very high, including high, advanced imaging use rates, narcotics, and physical treatments; (2) use of evidence-based treatments are low when compared with current best evidence; and (3) multiple treatments appear to be overused.

Approximately 7% of the US population seeks care from doctors of chiropractic (DCs) annually, representing nearly 200 million patient visits.[9] A national survey of patterns and perceptions of care found that 20% of those reporting back or neck pain sought chiropractic care.[10] Surveys suggest that patients are highly satisfied with chiropractic care.[11,12] Of chiropractic patients, 61% report their care as being "very helpful," whereas 27% report the same for conventional medical care.[10]

Currently, we know much more about the use of chiropractic care than we do about the costs associated with that care. A study performed by Carey and his colleagues[13] found that chiropractic care for an episode of LBP was less expensive than an orthopedic specialist but more than a primary care provider. Cherkin et al[14] found similar costs per episode between physical therapists and chiropractors, whereas Lind et al[15] found that patients seeing only conventional providers had fewer visits and greater costs than patients seeing nonconventional providers or a mix of traditional and nontraditional providers.

We know relatively little regarding the effect of differences in medical management on the cost of an episode of care by different types of providers. In this study, we examine the effect of initiating care for LBP with a medical doctor (MD) or with a DC in a system that has removed the traditional constraints imposed by insurance companies on a patient's use of and access to chiropractic care. We chose LBP as the focus of study because it is a condition that is prevalent, costly, and is treated by both MDs and DCs. This study evaluated if there were differences in the cost for LBP care when a patient chooses a course of treatment with an MD vs a DC, given their insurance provides them with equal access to both provider types.

Methods

An actuarial review of the Blue Cross Blue Shield of Tennessee's general health plans claims between October 1, 2004, and September 30, 2006, was undertaken. The Human Protections Administrator at Palmer College of Chiropractic, Davenport, Iowa, decided that this project was exempt from ethics review, and therefore, this study was not required to undergo institutional review board review. The subjects for this study were members of Blue Cross Blue Shield of Tennessee's intermediate and large group fully insured population between October 1, 2004, and September 30, 2006. Coverage for this population included unrestricted access to primary and specialty providers of their choice and unlimited services, except for a 20-visit per year limit on physical therapy. There were no differences in this population for co-pays or deductibles based on provider type.

Selection of Subjects

On the basis of the previous literature[16] and recommendations made by the American Chiropractic association, we identified members with a claim for LBP based on the presence of one of the following *International Classification of Diseases, Ninth Edition*, codes anywhere on a paid claim:

722.** : Intervertebral disk disorders
724.** : Other and unspecified disorders of back
729.** : Other disorders of soft tissues
739.** : Nonallopathic lesions not elsewhere classified
846.** : Sprains and strains of sacroiliac region
847.** : Sprains and strains of other and unspecified parts of back

Of the 669 320 members during this period, 85 402 members meet these criteria.

Computing Episodes of Care

Episodes of care for LBP were constructed for each of these 85 402 members. A new episode of care always began with a Current Procedures Terminology (CPT) code for an originating office visit to either a medical physician or a doctor of osteopathy, chiropractic manipulation, or an emergency department visit. All episodes of care beginning with other than these 3 procedure categories were eliminated.

On the basis of the episode treatment group, developed by Symmetry (now Ingenix), we used a clean period of 60 days between professional services for LBP to define the beginning of a new episode. Periods with continuous drug therapy between professional visits of more than 60 days were considered to be one episode if the drug was the same and continued refills occurred.

Episodes beginning within 60 days of the end of the study period and all episodes with a claim in the last 2 months of the study period were eliminated to eliminate all members with an incomplete claims record.

Assignment of Costs

Total episode costs for each episode of LBP included the cost paid by the insurer for all services provided during the episode by the same and other providers. Paid costs also include all pharmaceuticals for these members from the

Table 1. *Comparison of episode cost by initial provider type*

		n	Mean	Standard error	% Difference
Allowed amount	DC	36 280	$755.65	$9.38	27.13%
	MD	66 158	$1037.04	$12.47	
Paid amount	DC	36 280	$452.23	$8.03	38.89%
	MD	66 158	$740.07	$10.73	

Table 2. *Comparison of risk-adjusted episode cost by initial provider type*

		n	Mean	Standard error	% Difference
Risk-adjusted paid amount	DC	36 280	$532.54	$9.56	19.45%
	MD	66 158	$661.10	$29.16	

narcotic, analgesic, nonsteroidal, and muscle relaxant group and were also included in the total cost of care for each episode.

To examine the effect of the initial provider on the course of care and its subsequent cost, both an episode's allowed and paid costs were assigned to the episode's initial provider. For this analysis, we collapsed providers into 2 categories: MD and DC. All episodes originating with an emergency department visit were assigned to MD providers. Doctors of osteopathic medicine were also assigned to the MD category.

We also included allowed costs in the analysis to provide a baseline from which to judge the difference between the contracted rates, which depended heavily on benefit design (ie, co-pays and deductibles) and the actual paid claims.

Computation of Risk Scores

We specifically did not adjust episode costs for the patient's self-selection of an initial provider, as exploring this question was the primary object of this study. However, we did compute a risk score for each beneficiary using Symmetry Pharmacy Risk Groups (PRGs) to illuminate the effect of severity on episode costs. Symmetry PRGs use pharmacy claims, age, and sex to determine a severity or risk score for each member. All pharmacy claims for each beneficiary during the entire study period were used to assign a risk score to that beneficiary. We chose to use Symmetry PRGs because of its established predictive ability and industry acceptance.[17]

We used this tool to risk adjust our initial costs in the following manner:

- PRGs were applied to risk adjust each individual in totality (ie, all episodes for that individual). Thus, each individual had a common risk score applied to each of their episodes.
- Next, paid claims for each individual's episode were divided by the individual's risk score to produce a "risk-normalized cost" by episode. Thus, claims on individuals with more favorable risk scores were increased (ie, divided by a number less than 1.0). Claims on individuals with high-risk scores were decreased (ie, divided by a number greater than 1.0).

Results

Cost for episodes of care initiated with an MD or with a DC are shown below in Table 1.

We show both allowed and paid claims to give a fair assessment of the actual costs to the payer of the cost of care (paid claims) and the total cost of the care (allowed) that includes payments from third parties. In the case of episodes initiated with an MD, the difference between allowed and paid amounts is 71%, whereas for DCs, it is 60%. The difference between allowed and paid amounts is assumed to be covered by the beneficiary or some other third party. Because of unequal variances in the 2 distributions ($F = 713.317$, $P < .0001$ and $F = 743.228$, $P < .0001$, respectively), we tested for differences in mean allowed amounts as well as differences in the paid amounts using Satterthwaite's approximation of the standard t test.[18] Both allowed and paid amounts for episodes initiated with an MD and episodes initiated with a DC were significantly different ($t = -18.029$; $P = .000$; $t = -21.478$; $P = .000$).

In Table 2, we show the same data adjusted for each patient's disease burden using PRGs.

Again, because of unequal variances in the 2 distributions ($F = 20.123$; $P = .000$), we tested for differences in mean using Satterthwaite's approximation and again the differences were significant ($t = -04.189$; $P = .01$).[18]

Discussion

With both paid claims and allowed amount, we found statistically significant lower costs in episodes of care initiated with a DC as compared to an MD. In addition, we found that the risk-adjusted paid claims were also significantly lower for care initiated with a DC. In fact, about half the difference between the costs of care initiated with a DC vs an MD is due to risk selection. However, even with this self-selection effect based on risk, care initiated with a DC is still significantly, and sizeably, less for patients seeking care for the 6 *International Classification of Diseases, Ninth Edition*, low back-related disorders investigated in this study.

Although we treated these data as sample from a potential population of LBP patients, one can argue from the payer's view that this is indeed the population of LBP over the 2-year study period. This interpretation would lead us to consider not the statistical properties of the

sample but the savings to the payer for allowing DC-initiated episodes of care. In this instance, those savings would be more than $2.3 million per year (the difference in the actual cost for MD-initiated episodes and DC-initiated episodes).

Limitations

Several limitations are worth noting. First, these results are based on the experience of a single health insurer. The distribution of the type and number of providers in a geographic area is also known to affect the use of services. Also, treatment patterns for specific conditions differ by geography. Finally, this study does not address the mix of services provided, the cost of the individual services, or if chiropractic care is a substitute for conventional care. Further study looking at different aspects of cost across a variety of insurers and geographies are suggested.

Conclusions

This study provides a unique opportunity to evaluate an insured population with open access (including identical co-pays and deductibles) and an unlimited number of visits to providers via self-referral. Our results support a growing body of evidence that chiropractic treatment of low back pain is less expensive than traditional medical care. We found that episode cost of care for LBP initiated with a DC is less expensive than care initiated through an MD. Paid costs for episodes of care initiated with a DC were almost 40% less than episodes initiated with an MD. Even after risk adjusting each patient's costs, we found that episodes of care initiated with a DC are 20% less expensive than episodes initiated with an MD. Our results suggest that insurance companies that restrict access to chiropractic care for LBP may, inadvertently, be paying more for care than they would if they removed these restrictions.

Practical Applications

- For low back pain, care initiated with a chiropractor (DC) is less costly than care initiated through a Medical Doctor (MD). Paid costs for episodes of care initiated with a DC are almost 40% less then episodes initiated with an MD.
- Even after risk adjusting each patient's costs we found that episodes of care initiated with a DC are 20% less expensive than episodes initiated with an MD.

Funding Sources and Potential Conflicts of Interest

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References

1. Furlan AD, Brosseau L, Imamura M, et al. Massage for low-back pain: a systematic review within the framework of the Cochrane Collaboration Back Review Group. Spine 2002;27: 1896-910.
2. Deyo RA, Weinstein JN. Low back pain. N Engl J Med 2001; 344:363-70.
3. Luo X, Pietrobon R, Sun SX, et al. Estimates and patterns of direct health care expenditures among individuals with back pain in the United States. Spine 2004;29:79-86.
4. Deyo RA, Mirza SK, Martin BI. Back pain prevalence and visit rates: estimates from U.S. national surveys, 2002. Spine 2006;31:2724-7.
5. Druss BG, Marcus SC, Olfson M, Pincus HA. The most expensive medical conditions in america. Health Aff 2002;21: 105-11.
6. Stewart WF, Ricci JA, Chee E, Morganstein D, Lipton R. Lost productive time and cost due to common pain conditions in the US workforce. JAMA 2003;290:2443-54.
7. Ricci JA, Stewart WF, Chee E, Leotta C, Foley K, Hochberg MC. Back pain exacerbations and lost productive time costs in United States workers. Spine 2006;31:3052-60.
8. Carey TS, Freburger JK, Holmes GM, et al. A long way to go: practice patterns and evidence in chronic low back pain care. Spine 2009;34:718-24.
9. Barnes PM, Bloom B, Nahin RL. Complementary and alternative medicine use among adults and children: United States, 2007. Natl Health Stat Report 2009:1-23.
10. Pengel HM, Maher CG, Refshauge KM. Systematic review of conservative interventions for subacute low back pain. Clin Rehabil 2002;16:811-20.
11. Ferreira ML, Ferreira PH, Latimer J, Herbert R, Maher CG. Does spinal manipulative therapy help people with chronic low back pain? Aust J Physiother 2002;48:277-84.
12. Furlan AD, Clarke J, Esmail R, Sinclair S, Irvin E, Bombardier C. A critical review of reviews on the treatment of chronic low back pain. Spine 2001;26:E155-62.
13. Carey TS, Garrett J, Jackman A, et al. Low back pain among patients seen by primary care practitioners, chiropractors, and orthopedic surgeons. The North Carolina Back Pain Project. N Engl J Med 1995;333:913-7.
14. Cherkin DC, Deyo RA, Battie M, et al. Comparison of physical therapy, chiropractic manipulation, and provision of an educational booklet for the treatment of patients with low back pain. N Engl J Med 1998;339:1021-9.
15. Lind BK, Lafferty WE, Tyree PT, Sherman KJ, Deyo RA, Cherkin DC. The role of alternative medical providers for the outpatient treatment of insured patients with back pain. Spine 2005;30:1454-9.
16. Grieves B, Menke JM, Pursel KJ. Cost minimization analysis of low back pain claims data for chiropractic vs medicine in a managed care organization. J Manipulative Physiol Ther 2009;32:734-9.
17. Winkleman R, Mehmud S. A comparative analysis of claims-based tools for health risk assessment. Society of Actuaries 2007:1-70.
18. Satterthwaite FE. An approximate distribution of estimates of variance components. Biom Bull 1946;2:110-4.

APPENDIX 3

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ISSLS Prize Winner: Early Predictors of Chronic Work Disability

A Prospective, Population-Based Study of Workers With Back Injuries

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Study Design. Prospective population-based cohort study.

Objective. To identify early predictors of chronic work disability after work-related back injury.

Summary of Background Data. Identification of early predictors of prolonged disability after back injury could increase understanding concerning the development of chronic, disabling pain, and aid in secondary prevention. Few studies have examined predictors across multiple domains in a large, population-based sample.

Methods. Workers (N = 1885) were interviewed 3 weeks (average) after submitting a lost work-time claim for a back injury. Sociodemographic, employment-related, pain and function, clinical, health care, administrative/legal, health behavior, and psychological domain variables were assessed *via* worker interviews, medical records, and administrative databases. Logistic regression analyses identified early predictors of work disability compensation 1 year after claim submission.

Results. Significant baseline predictors of 1-year work disability in the final multidomain model were injury severity (rated from medical records), specialty of the first health care provider seen for the injury (obtained from administrative data), and worker-reported physical disability (Roland-Morris disability questionnaire), number of pain sites, "very hectic" job, no offer of a job accommodation (*e.g.*, light duty), and previous injury involving a month or more off work. The model showed excellent ability to discriminate between workers who were/were not disabled at 1 year (area under the receiver operating characteristic curve = 0.88, 95% CI = 0.86–0.90).

Conclusion. Among workers with new lost work-time back injury claims, risk factors for chronic disability include radiculopathy, substantial functional disability, and to a lesser extent, more widespread pain and previous injury with extended time off work. The roles of employers and health care providers also seem important, supporting the need to incorporate factors external to the worker in models of the development of chronic disability and in disability prevention efforts.

Key words: back pain, injured workers, predictors, risk factors, biopsychosocial, work disability, workers' compensation, prospective cohort study. **Spine 2008;33: 2809–2818**

Although low back pain is the most prevalent and costly disabling work-related condition,[1–6] only a small fraction of workers with acute back pain progress to chronic disability and these account for the majority of costs.[4,7–10] The identification of early predictors of prolonged disability could help increase knowledge concerning why some workers become chronically disabled from back injuries whereas others do not, and lead to more effective secondary prevention efforts focused on modifiable risk factors. Knowledge of early predictors could also aid in the development of predictive models and screening tools to identify high-risk workers soon after injury so that interventions could be targeted to those workers at an early stage. However, studies of predictors of chronic back disability in workers' compensation and other settings have yielded inconsistent findings, likely reflecting differences in samples, methods, and measures.[11] Little research has examined prognostic factors assessed within a few weeks after back pain onset.[12–14] Furthermore, few studies have assessed risk factors across multiple domains in a large, population-based sample at any time within the first 3 months.[15]

With the objective of identifying early predictors of chronic work disability, we conducted a prospective cohort study of workers with recently submitted workers' compensation claims for back injuries.[16,17] Among 1068 workers enrolled in the first year of the study, characteristics in each predictor domain examined (sociodemographic, pain and disability, and psychosocial) were associated with work disability 6 months later.[17] Our previous report did not examine longer-term outcomes or factors from other potentially important domains.

The current report presents the final study results identifying early risk factors for longer-term (1 year) work disability. Guided by a concept of chronic work disability as influenced by multiple factors, we assessed potential predictors in a comprehensive set of domains. We hypothesized that variables in sociodemographic,

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employment-related, pain and function, clinical, health care, administrative/legal, health behavior, and psychological domains, assessed soon after a work-related back injury, would be significant predictors of chronic disability, and that factors from different domains would add unique information in a multivariable model predicting chronic disability.

■ Materials and Methods

Study Participants and Procedures

The Washington Workers' Compensation Disability Risk Identification Study Cohort is a prospective, population-based study to identify risk factors for chronic musculoskeletal disorder disability.[16,17] Workers with back injury claims involving at least 4 days of lost work time (the requirement for temporary total disability wage replacement) were identified through weekly reviews of the Washington State Department of Labor and Industries claims database July 2002 through April 2004, and approached *via* telephone for study enrollment and a baseline interview. We examined all claims covered by the State Fund, which insures approximately two-thirds of nonfederal Washington workers. The other third, employed by larger self-insured companies, were excluded because of insufficient administrative data.

Among 4354 claimants identified, 2147 (49.3%) enrolled and completed the baseline interview, 1178 (27.1%) could not be contacted, 120 (2.8%) were ineligible (*e.g.*, unable to complete the interview in English or Spanish), and 909 (20.9%) declined enrollment. Because the intended study population was workers who received some wage replacement compensation, we excluded from analysis 240 subjects who received no compensation in the first year. We also excluded subjects whose data were missing on age (n = 3), hospitalized for their injury (n = 16), or not confirmed to have a back injury on medical record review (n = 3). The final sample (N = 1885), compared with study nonparticipants who received work disability compensation (N = 1776), was slightly older [age mean (SD) = 39.4 (11.2) *vs.* 38.2 (11.1) years, $P = 0.001$]; included more women (32% *vs.* 26%, $P < 0.001$) and more workers receiving compensation at 1 year (13.8% *vs.* 11.3%, $P = 0.02$); and had more work disability days at 1 year [median = 17 (interquartile range, IQR, 5–104) *vs.* 13(4–60) days, $P < 0.001$].

Measures

Predictors. Baseline measures from the 8 risk factor domains (Table 1) were selected based on previous research[15,16,18,19] suggesting their potential importance. They were obtained from worker interviews, Department of Labor and Industries administrative databases, and medical record review (the injury severity rating, shown to have substantial inter-rater reliability[20]).

Outcome: Work Disability. The primary outcome was wage replacement compensation for temporary total disability ("work disability") 12 months after claim submission. Temporary total disability payments are stopped when a worker returns to work or is judged to be medically stable and able to work.

Statistical Analysis

Statistical analyses were carried out in 3 steps. First, we used logistic regression to examine bivariate associations between the baseline measures and 1-year work disability. Second, separately for each risk factor domain, variables in the domain that were associated bivariately ($P < 0.10$) with 1-year disability were entered with age and gender in a forward stepwise logistic regression analysis predicting 1-year disability. We used $P < 0.10$ as a criterion for entry in the stepwise analysis because use of the traditional 0.05 level may exclude variables that are important in multivariable models.[21] Third, we entered predictors that remained in the final step in each domain model, along with age and gender, in a multidomain logistic regression model predicting 1-year disability. The model did not change meaningfully according to inclusion or exclusion of the Spanish interviews (n = 188).

To evaluate the ability of the multidomain model to discriminate between workers who were/were not disabled at 1 year, we calculated the area under the receiver operating characteristic curve (AUC). An AUC of 0.50 indicates no discrimination, 0.70 to 0.80 indicates acceptable discrimination, and 0.80 to 0.90 indicates excellent discrimination (AUC $\geq$0.90 is rare).[21] To estimate the AUC that would be obtained in different samples, we used cross-validation methods, creating 10 mutually exclusive random 10% subsets of the sample, with each subset serving as a test sample for evaluating the model derived from the other 90% of the sample; average performance over the 10 repetitions was calculated.[22]

■ Results

Sample Characteristics

The sample (N = 1885) was predominantly male (68%) and white non-Hispanic (70%; 16% Hispanic; 14% other). The median number of days between claim submission and the baseline interview was 18 (IQR = 15–26). At 1 year, 261 (13.8%) subjects were receiving work disability compensation and the median number of work disability days among all subjects was 17 (IQR = 5–104).

Bivariate and Within-Domain Predictors of One Year Work Disability

The baseline variables in each risk factor domain and their bivariate associations with 1-year work disability are shown in Table 1. None of the health behavior domain variables (tobacco use, alcohol use, body mass index) predicted the outcome; thus, they were not analyzed further.

For each other domain, bivariate predictors were entered in an age- and sex-adjusted stepwise regression analysis. Education was the only variable in the final step of the sociodemographic domain analysis, with better outcomes for college-educated workers. Multiple variables remained in the final step for the employment-related domain: worker's industry, amount of heavy lifting, perception of job as very hectic, employer willingness to provide a job accommodation (*e.g.*, light duty, reduced hours), and employer offer of a job accommodation. Number of pain sites, pain interference with activities, pain change since injury, and Roland-Morris disability questionnaire (RDQ)[23] and SF-36 version 2 [24] role-physical and physical function scores remained in the final step of the pain and function domain analysis. In the clinical domain, the injury severity rating and self-reported pain radiating below the knee, previous work-related injury involving a month or more off work, and health in the year before injury remained in the final step. Specialty of the first health care provider seen for the

Table 1. Baseline Measures in Each of Eight Risk Factor Domains and Their Bivariate Associations With One Year Work Disability

Domain	Categories of Each Measure
Measure	
Sociodemographic	
Age, yr*	≤24, 25–34, 35–44, 45–54, ≥55
Gender	Male, female
Urban/rural residence†	Urban, suburban, large town, small town
Race/ethnicity	White non-Hispanic, Hispanic, other
Education‡	Less than high school, high school, vocational or some college, college
Marital status	Married/living with partner, other
Employment-related	
Worker's employer size§	>200, 76–200, 26–75, 11–25, 1–10 employees
Worker's industry§¶	Natural resources, construction, manufacturing, trade/transportation, management, education and health, hospitality
Employer participation in retrospective rating program (premium refunds/additional charges if claim costs are lower/higher than anticipated)§	Participating, not participating
Unemployment rate, worker's county of residence, quarter in which injured‖	Quartiles
Worker's description of job	
Heavy lifting‡	1 = not at all to 5 = constantly
Whole body vibration¶	1 = not at all to 5 = constantly
Physical demands**	1 = sedentary to 5 = very heavy
Fast pace¶	1 = strongly disagree to 4 = strongly agree
Excessive amount of work*	1 = strongly disagree to 4 = strongly agree
Enough time to do job**	1 = strongly disagree to 4 = strongly agree
Very hectic*	1 = strongly disagree to 4 = strongly agree
Able to take breaks when desired‡	1 = strongly disagree to 4 = strongly agree
Supervisor listens to my work problems*	1 = strongly disagree to 4 = strongly agree
Satisfaction with job	1 = not at all satisfied to 4 = very satisfied
Co-worker relations	0 (don't get along at all)–10 (get along extremely well)
Job type at time of injury**	Full-time, part-time
Seasonal job at injury?	Yes, no
Temporary job at injury?	Yes, no
Job duration¶	<6 mo, ≥6 mo
Employer willing to provide job accommodation (*e.g.*, light duty, reduced hr)*	Yes, no
Employer offered job accommodation*	Yes, no
Pain and function	
No. pain sites*	0–8 possible sites
Pain intensity, past wk[51]*	0–10 scale
Pain interference with daily activities, past wk[51]*	0–10 scale
Pain interference with work, past wk[51]*	0–10 scale
Roland questionnaire[23]*	0–24 scale
SF-36 v2 (1 wk)[24] PF*	>50, 41–50, 30–40, <30
SF-36 v2 (1 wk)[24] RP*	>50, 41–50, 30–40, <30
Pain change since injury*	Better, same, worse
Clinical status	
Work loss back claims, past 5 yr*§	Yes, no
Non-work-loss back claims, past 5 yr§	Yes, no
Work loss claims, any type, past 5 yr*§	Yes, no
Non-work-loss claims, any type, past 5 yr§¶	Yes, no
Injury severity[20]††	Mild sprain/strain, major sprain/strain with substantial immobility but no evidence of nerve injury/radiculopathy, evidence of radiculopathy, reflex/sensory/motor abnormalities
Pain radiates below knee*	Yes, no
Previous similar back symptoms	Yes, no
Previous injury (any type) with ≥1 mo off work*	Yes, no
No. of workers' compensation claims before this injury*	0, 1–4, >4
Work d missed because of back, previous yr¶	0, 1–7, 8–29, ≥30
Work d missed because of other problems, previous yr	0, 1–29, ≥30
No. other major medical problems**	0, ≥1
Current health aside from injury	Excellent, very good, good, fair, poor
Health, yr prior to injury**	Excellent, very good, good, fair, poor
Health care	
Specialty, first provider seen for injury*§	Primary care, occupational medicine, chiropractor, other
Health care provider recommended exercise	Yes, no
Health care provider discussed ways to prevent further injury‡	Yes, no
Health insurance‡	Through employer, through other source, none
Administrative/legal	

(*Continued*)

Table 1. Continued

Domain	Categories of Each Measure
Time from injury to first medical visit for injury‡§	0–6, 7–13, ≥14 d
Time from first medical visit for injury to claim receipt‡§	0–13, ≥14 d
Attorney for claim‡	Yes, no
Health behavior	
Tobacco use	Yes, no
Alcohol Use Disorders Identification Test-Consumption (AUDIT-C)[52]	0–12 scale
BMI	<25, 25–29, ≥30
Psychological	
Catastrophizing*‡‡	0–4 scale
Blame for injury[53]	Work, self, someone/something else, nothing/no one
Recovery Expectations[53]*	0 = not at all certain to 10 = extremely certain will be working in 6 mo
Work fear-avoidance*§§	0–6 scale
SF-36v2 (1 wk) Mental Health[24]*	>50, 41–50, 30–40, <30

*$P < 0.001$ in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
†By zipcode, using the http://www.doh.wa.gov/Data/Guidelines/RuralUrban classification.
‡$P < 0.01$, in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
§From workers' compensation database.
¶$P < 0.05$, in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
‖Obtained from http://www.workforceexplorer.com.
**$P < 0.10$, in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
††Rated by trained nurses based on medical records early in the claim.
‡‡Mean of responses to 3 questions from the Pain Catastrophizing scale.[54]
§§Mean of responses to two questions from the Fear-Avoidance Beliefs Questionnaire work scale.[55]
All measures were obtained from the worker baseline interview, except where noted otherwise. Income was assessed in the baseline interview and was not associated bivariately with 1-year work disability. A large no. of workers declined to provide income information; education (which was associated bivariately with 1-year disability) was used instead as an indicator of socioeconomic status.
BMI indicates body mass index (calculated from self-reported height and weight); PF, Physical Function; RP, Role-Physical.

injury and source of general health insurance were in the final step of the health care domain analysis. All 3 administrative/legal predictors remained in the final step: time from injury to the first medical visit for the injury, time from first medical visit to claim receipt, and attorney retention. In the psychological domain, catastrophizing, recovery expectations, work fear-avoidance, and SF-36v2[24] mental health remained in the final step.

Multidomain Model Predictors of One Year Work Disability

The final multidomain model (Table 2) included the variables in the final steps of the domain-specific stepwise regression analyses, except for a few variables that were excluded because of redundancy with other predictors (Table 2). Variables from each domain except administrative/legal and psychological contributed independently ($P < 0.05$) to the prediction of 1-year work disability. The statistically significant predictors were injury severity, RDQ score, number of pain sites, previous injury involving 1 month or more off work, specialty of first provider, offer of job accommodation, and perception of job as very hectic. The AUC (95% CI) was 0.88 (0.86–0.90). As expected, the cross-validated AUC was slightly lower (0.84).

The strongest predictor in the multidomain model, as well as bivariately, was the RDQ. Adjusting for all other predictors, workers with scores ≥18 were 7 times more likely than workers with scores <12 to receive work disability compensation at 1 year. Table 3 shows, for each category of each significant predictor in the multidomain model, the percent of workers who were disabled and the median number of work disability days at 1 year. Among workers with baseline RDQ scores <12, only 2% were disabled at 1 year and the median number of disability days was 6. Among workers with RDQ scores ≥18 (n = 624), 30% were disabled at 1 year (median number of disability days = 117).

The injury severity rating based on medical records early in the claim was also strongly associated with 1-year work disability. Compared with workers who had a mild sprain/strain, workers with a major sprain/strain did not differ significantly, but those with radiculopathy without reflex/sensory/motor abnormalities had almost twice the odds of 1-year disability and those with reflex/sensory/motor abnormalities had 3.7 times the odds, adjusting for other predictors (Table 2). At 1 year, 26% of those with radiculopathy without reflex/sensory/motor abnormalities and 39% of those with these objective findings were disabled (Table 3).

To better understand why psychological variables were not significant in the multidomain model despite being strong bivariate predictors, we conducted additional analyses. Each psychological measure contributed significantly to the multidomain prediction of 1-year

Table 2. Final Multidomain Model Predicting One Year Work Disability: Crude (Unadjusted) and Adjusted Odds Ratios (95% CI) for Baseline Predictors

Baseline Predictor	% of sample	Prediction of 1 Yr Work Disability			
		Crude OR	95% CI	Adjusted OR	95% CI
Age, yr (ref = 35–44)	31				
≤24	11	0.32	0.17–0.59	0.54	0.26–1.11
25–34	25	0.55	0.38–0.79	0.73	0.46–1.16
45–54	23	1.04	0.75–1.44	1.00	0.66–1.54
≥55	10	0.78	0.49–1.25	1.03	0.56–1.89
Gender (ref = females)	32				
Males	68	0.99	0.75–1.31	1.11	0.73–1.70
Education (ref = high school)	34				
Less than high school	13	1.18	0.80–1.73	0.92	0.55–1.54
Vocational or some college	44	0.77	0.57–1.04	0.78	0.54–1.14
College	9	0.39	0.21–0.75	0.53	0.23–1.18
Industry (ref = Trade/transportation)	25				
Natural resources	5	1.27	0.66–2.44	1.02	0.42–2.48
Construction	18	1.89	1.28–2.82	1.88	1.12–3.17
Manufacturing	8	1.66	0.99–2.77	1.98	1.04–3.77
Management	16	1.15	0.74–1.78	1.08	0.62–1.89
Education/health	15	1.00	0.63–1.60	0.92	0.49–1.74
Hospitality	13	1.24	0.78–1.98	1.05	0.58–1.91
Heavy lifting (ref = not at all/occasional)	47				
Frequent	31	1.21	0.88–1.64	0.84	0.56–1.27
Constant	22	1.66	1.20–2.30	1.20	0.79–1.83
Job is hectic (ref = disagree)	28				
Agree	45	1.90	1.32–2.75	1.84	1.16–2.91
Strongly agree	27	2.62	1.78–3.85	2.16	1.32–3.54
Job accommodation (ref = offered)	45				
Not offered	55	3.00	2.22–4.04	1.91	1.31–2.76
No. pain sites (ref = 0–2)	46				
3–4	38	5.61	3.91–8.04	1.92	1.22–3.03
≥5	16	5.47	3.60–8.31	1.71	1.01–2.92
RDQ score (ref = 0–11)	40				
12–15	17	5.47	2.72–10.99	3.11	1.45–6.63
16–17	11	13.31	6.78–26.13	5.03	2.33–10.89
18–24	33	26.10	14.39–47.35	7.01	3.44–14.29
Pain change since injury (ref = better)	68				
Unchanged	20	4.72	3.44–6.47	1.47	0.98–2.20
Worse	11	7.15	5.01–10.22	1.31	0.81–2.11
Injury severity (ref = mild sprain/strain)	55				
Major sprain/strain	20	1.95	1.35–2.84	1.28	0.80–2.03
Radiculopathy	21	4.44	3.22–6.13	1.95	1.30–2.91
Reflex/sensory/motor abnormalities	3	7.93	4.56–13.78	3.72	1.83–7.58
Previous injury with ≥1 mo off work (ref = no)	73				
Yes	27	2.42	1.85–3.17	1.62	1.14–2.31
Health, previous yr (ref = excellent)	23				
Good	67	0.71	0.53–0.96	0.64	0.44–0.95
Fair/poor	11	0.84	0.53–1.34	0.56	0.31–1.03
First provider (ref = primary care)	36				
Occupational medicine	7	2.64	1.66–4.20	1.78	0.99–3.20
Chiropractor	29	0.38	0.24–0.60	0.41	0.24–0.70
Other	29	2.21	1.63–3.01	1.93	1.31–2.84
Health insurance (ref = no insurance)	32				
Insurance, not through employer	17	0.92	0.64–1.32	0.96	0.60–1.53
Insurance through employer	50	0.61	0.45–0.81	0.66	0.44–0.99
Injury to first medical visit, d (ref = 0–6)	79				
7–13	12	1.08	0.71–1.65	0.76	0.45–1.29
≥14	9	2.04	1.38–3.01	1.09	0.66–1.78
Medical visit to claim receipt, d (ref = <14)	83				
≥14	17	1.63	1.19–2.24	1.32	0.87–1.99
Attorney for claim (ref = no)	98				
Yes	2	2.76	1.38–5.50	1.32	0.54–3.27
Catastrophizing* [ref = 0–1 (very low)]	30				
Low (>1–<2)	16	2.58	1.47–4.52	1.05	0.53–2.09
Moderate (2–<3)	30	4.58	2.85–7.36	1.06	0.58–1.93
High (3–4)	24	8.20	5.14–13.08	1.33	0.71–2.48

(Continued)

Table 2. Continued

Baseline Predictor	% of sample	Prediction of 1 Yr Work Disability			
		Crude OR	95% CI	Adjusted OR	95% CI
Recovery expectations [ref = 10 (very high)]	56				
Low (0–6) or declined to answer	24	4.29	3.16–5.82	1.30	0.87–1.96
High (7–9)	20	2.07	1.44–2.98	1.21	0.77–1.90
Fear-avoidance* [ref = <3 (very low)]	20				
Low-moderate (>3–<5)	32	1.83	1.11–3.04	1.38	0.73–2.62
High (5–<6)	30	3.27	2.02–5.31	1.67	0.89–3.13
Very high (6)	18	5.09	3.10–8.38	1.71	0.88–3.30
Mental health† [ref = >50 (above population mean)]	38				
41–50	25	2.70	1.80–4.05	1.11	0.66–1.87
30–40	22	3.60	2.41–5.38	0.86	0.51–1.47
<30	15	5.83	3.88–8.78	1.10	0.63–1.94

*Higher scores indicate worse psychological status.
†Higher scores indicate better psychological status.
Each baseline variable in this table was associated bivariately ($P < 0.10$) with 1-year work disability and also remained in the final step of the domain-specific stepwise logistic regression analysis (the criteria for entry in the multidomain model). Several variables that remained in the final step of the domain-specific analysis were excluded from the final multidomain model shown in this table because of conceptual and statistical redundancy. Because of collinearity of the multiple measures of disability/activity limitations (correlations between the PF, RP, RDQ, and activity interference measures ranged from $r = 0.60–0.74$), we excluded from the final model all activity limitations measures except the RDQ, which had the strongest bivariate association with 1-year work disability. Similarly, although both employer willingness to offer a job accommodation and actual offer of an accommodation remained in the final step of the employment domain model, we used only actual offer in the final multidomain model because the 2 variables were highly associated and the latter question had better measurement and statistical properties. Finally, although self-reported pain radiating below the knee remained in the final step of the clinical status domain model, it was not statistically significant when entered with injury severity in the multidomain model and was excluded from the final multidomain model because of its redundancy with the injury severity measure.
Variables in bold are significant ($P < 0.05$) predictors of one-year work disability after adjustment for all other variables in model.
ref indicates reference group.

work disability when the RDQ and the other psychological variables were not in the model (Table 4). The RDQ was correlated substantially with each psychological measure (*e.g.*, $r = 0.51$ with catastrophizing, $r = 0.54$ with mental health).

■ Discussion

This is the largest prospective, population-based study to date of risk factors for chronic work disability identified early after back injury from a large number of potential risk factors in multiple domains, assessed from multiple sources. The final multidomain model had excellent ability to discriminate workers who were disabled at 1 year from those who were not. The results support the importance of factors in multiple domains in the development of chronic work disability. Variables in 7 of the 8 domains assessed were bivariate predictors of 1-year work disability and variables in 4 domains (employment related, pain and function, clinical status, and health care) were significant in the multidomain model. Although injury severity was a strong predictor of chronic work disability, other factors were also significant after controlling for injury severity. This confirms clinical impressions that patients with similar examination and imaging findings vary in pain and disability outcomes, likely because of factors other than biologic ones.

Workers with radiculopathy had significantly worse long-term outcomes, consistent with previous findings that back pain radiating into the leg is associated with longer work disability.[13,25–33] These results support the utility of our injury severity measure (and of self-report measures of radiating leg pain when medical record review is not possible), and the need to adjust for injury severity in studies of predictors of chronic back pain disability. Further research is needed to better understand why early radicular pain predicts chronic work disability. The extent to which this is due to persistent disease and associated pain that interferes with ability to work, *versus* other factors, is unclear. For example, patients with radicular pain may be more likely to receive imaging tests with findings that increase both their and their health care providers' fear-avoidance beliefs, which in turn may lead to work and activity avoidance, thus inadvertently promoting chronic disability. Workers with objective signs of more severe radiculopathy (reflex, sensory, or motor abnormalities) had almost twice the odds of long-term disability compared with workers with radicular pain alone, suggesting the potential usefulness of differentiating these 2 groups in future research.

The strongest predictor of 1-year work disability was the RDQ (although other self-report measures of functional limitations were also significant). Previous studies have also found that self-reported physical disability is positively associated with time to return to work after back injury[11,13,26–28,34] and seems to be more important than pain intensity in predicting work disability duration.[13] Number of pain sites was also associated positively with chronic disability, consistent with previous observations that more widespread musculoskeletal pain

Table 3. Significant ($P < 0.05$) Baseline Predictors (in Final Multidomain Model) of Work Disability 1 yr After Submission of a Back Injury Work-Loss Claim: Percent Receiving Work Disability Compensation and Number of Work Disability Days at 1 Year (N = 1885)

		Work Disability D, Yr After Claim Submission	
Predictor	Disabled at 1 Yr %	Median	IQR
Injury severity			
Mild sprain/strain	8	8	3–34
Major sprain/strain	14	23	7–96
Radiculopathy	26	104	16–301
Reflex/sensory/motor abnormalities	39	94	31–368*
RDQ			
0–11	2	6	3–14
12–15	8	16	5–62
16–17	18	28	8–166
18–24	30	117	29–321
Job is hectic			
Disagree	8	14	4–62
Agree	14	17	5–114
Strongly agree	19	23	5–154
Job accommodation			
Accommodation offered	7	10	4–30
Accommodation not offered	19	35	7–200
No. pain sites			
0–2	5	8	3–27
3–4	22	40	8–223
≥5	21	46	8–236
Previous injury with more than 1 mo off work			
No	11	14	4–72
Yes	22	35	8–221
First provider for injury			
Primary care	12	14	4–77
Occupational medicine	26	70	5–259
Chiropractor	5	14	4–44
Other	23	30	5–239

*Compensation can be for days off work previous to claim submission; thus, disability days can total more than 365 in first year after claim submission.
Values shown in table are unadjusted.
IQR indicates interquartile range.

is a risk factor for worse pain and disability outcomes.[35–37]

Although the brief measures of mental health, fear-avoidance, and catastrophizing were strong predictors of chronic work disability bivariately, each was statistically significant in the multidomain model only when the RDQ was excluded. These psychological variables are strongly associated with pain-related disability; cause-effect relations are complex and likely reciprocal. Given this, it would seem prudent clinically to screen patients with back pain for these psychological factors. Use of full, standardized measures rather than abbreviated versions might have yielded stronger associations with 1-year work disability; this needs to be examined in future studies.

Workers whose first health care visit for the injury was to a chiropractor had substantially better outcomes. Patients who see chiropractors for back pain differ in important ways from those who see medical physicians[38,39] and it is possible that workers who saw chiropractors differed in prognostically favorable ways not represented in the multidomain model. It is also possible that chiropractic care was more effective in improving pain and disability and/or promoting return to work. We did not examine providers or care after the first visit; further research is needed to investigate the effects of early care on work disability.

Employer offer of an accommodation (*e.g.*, light duty, reduced hours) to facilitate return to work has been identified consistently as protective against chronic work disability.[28,34,40] Adjusting for other predictors, workers in our study who were not offered such an accommodation by about 3 weeks after submitting a lost work-time claim had almost twice the odds of chronic work disability. These findings suggest that employer offer of accommodations to facilitate working in the first few weeks after injury may play an important role in chronic disability prevention.

The study findings also highlight the importance of other job factors in work disability. Several measures of job physical and psychological demands were significant predictors bivariately; among these, worker perception of his/her job as very hectic was the strongest predictor in the multidomain model. Other studies of workers with back injuries found that similar views (that their jobs required working very hard and involved an excessive amount of work) predicted longer work disability duration.[26,31]

Some factors that were not significant predictors in the multidomain model warrant comment. These include having an attorney for the claim. Very few workers had an attorney at the time of the interview; attorney retention generally occurs later in a claim when a worker is concerned about claim closure. Older age, found to be a risk factor in many,[11,18,29,41] but not all,[13,42] previous studies, was not significant in the multidomain model. In bivariate analysis, workers younger than 35 years had lower odds of chronic work disability, whereas those in different age groups above 34 years had similar odds. Consistent with a systematic review's conclusion that there is strong evidence that a history of back pain does not predict sick leave duration,[13] history of back pain was not significant. However, history of substantial time off work because of back or other injury was significant.

Health care providers evaluating patients with recent work-related back injuries might consider radicular pain (especially with objective signs of more severe radiculopathy), substantial physical disability, widespread pain, and previous injury with time off work as risk factors for chronic disability. For patients with these characteristics, close monitoring and early intervention aimed at improving function and facilitating return to work (*e.g.*, contact with employer to discuss job modifications) may help prevent chronic work disability.

A study limitation is that not all potential participants enrolled, and participants may have differed from the larger population in ways that might have affected the results.

Table 4. Association of Each Baseline Psychological Measure With One Year Work Disability, Adjusted for All Other Variables in Final Multidomain Model Except the Roland-Morris Disability Questionnaire and the Other Psychological Measures

Baseline Psychological Measure	Adjusted OR	95% CI	Disabled at 1 Yr %	Work Disability D, Yr After Claim Submission	
				Median	IQR
Catastrophizing* [ref = 0–1 (very low)]			4	7	3–20
Low (>1–<2)	1.44	0.76–2.72	10	16	4–74
Moderate (2–<3)	1.68	0.97–2.93	16	27	7–145
High (3–4)	2.41	1.37–4.22	26	70	10–302
Recovery expectations [reference = 10 (very high)]			8	11	4–36
High (7–9)	1.45	0.95–2.23	15	21	5–129
Low (0–6) or declined to answer	1.76	1.20–2.58	27	91	13–322
Fear-avoidance* [reference = ≤3 (very low)]			6	7	3–24
Low-moderate (>3–<5)	1.60	0.87–2.95	10	12	4–45
High (5–<6)	2.02	1.11–3.69	17	31	6–183
Very high (6)	2.21	1.17–4.17	24	66	10–266
Mental health† [ref = >50 (above population mean)]			6	7	3–24
41–50	1.54	0.94–2.51	14	17	5–106
30–40	1.69	1.05–2.73	18	35	7–209
<30	2.21	1.32–3.71	26	84	18–295

*Higher scores indicate worse psychological status.
†Higher scores indicate better psychological status.
Values for percent disabled at 1 yr and number of work disability days are observed.

Further research is needed to confirm our findings with different samples in different settings. However, the consistency of our results with those in other studies supports their robustness. Another limitation is the use of abbreviated measures. This was necessary to assess a large number of constructs within an acceptable interview length, but the abbreviated measures may have psychometric properties inferior to those of longer measures. Full, validated measures might show different associations with the outcome. Strengths of the study include a large population-based sample; prospective design; risk factors across multiple domains assessed *via* worker-reported information, medical records, and administrative data obtained soon after claim submission; and objective administrative measures of work disability compensation with complete follow-up data.

The study findings support an understanding of the development of chronic disabling back pain as involving interactions of factors in domains both within and external to the patient. The biopsychosocial model of chronic pain has gained widespread acceptance, and both biologic and psychological factors have been demonstrated to play important roles in chronic pain and associated disability,[43] and in the transition from acute to chronic pain.[44,45] However, although Fordyce[46] emphasized the importance of environmental factors and the complex interplay between internal and external factors in chronic pain over a decade ago, environmental variables have received relatively little empirical attention in the study of the development of chronic disabling pain.[43,47] The typically applied biopsychosocial perspective lacks focus on health care provider, employer, and family responses, and work and economic factors, that affect disability, and has the added problem of lacking rigorous conceptual grounding. There is a need for a more robust and comprehensive conceptual framework that includes environmental influences in addition to biologic and psychological ones.

Perhaps just as there has been growing awareness of the importance of environmental (including economic and social) factors in other health conditions (*e.g.*, obesity[48,49]) that previously were viewed as having largely biologic/genetic and psychological determinants, more attention needs to be directed toward environmental factors that may interact with genetic/biologic and psychological factors in influencing patient responses to back pain. The view of the health of individuals as shaped by social, economic, and environmental conditions has resulted in consideration of new health risks and protective factors that are predictive of a wide variety of medical outcomes.[50] Such a view may well prove fruitful in the study of disabling pain. Ultimately, the societal problem of chronic disabling back pain will likely require the development of new, expanded approaches to prevention and treatment that take account of the influence of a variety of environmental factors.

■ Key Points

- Knowledge concerning early predictors of prolonged disability after back injury could help increase understanding concerning the development of chronic, disabling pain, and aid in secondary prevention efforts.

- Among 1885 workers with new workers' compensation claims for lost work-time because of back injury, injury severity, physical disability (Roland disability questionnaire), number of pain sites, description of job as "very hectic," no offer of a job accommodation to enable return to work (*e.g.*, light duty, reduced hours), previous injury involving a month or more off work, and specialty of the first health care provider for the injury were statistically significant in a multivariable model predicting receipt of work disability compensation 1 year later.
- Models of the development of chronic work disability after work-related back injury need to be broadened beyond the typically applied biopsychosocial approach to incorporate environmental factors such as workplace characteristics.

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References

1. Frank JW, Kerr MS, Brooker AS, et al. Disability resulting from occupational low back pain. Part I: What do we know about primary prevention? A review of the scientific evidence on prevention before disability begins. *Spine* 1996; 21:2908–17.
2. Rossignol M, Suissa S, Abenhaim L. Working disability due to occupational back pain: three-year follow-up of 2,300 compensated workers in Quebec. *J Occup Med* 1988;30:502–5.
3. Tate DG. Workers' disability and return to work. *Am J Phys Med Rehabil* 1992;71:92–6.
4. Cheadle A, Franklin G, Wolfhagen C, et al. Factors influencing the duration of work-related disability: a population-based study of Washington State workers' compensation. *Am J Public Health* 1994;84:190–6.
5. Courtney TK, Webster JS. Disabling occupational morbidity in the United States. *J Occup Environ Med* 1999;41:60–9.
6. Guo H, Tanaka S, Halperin WE, et al. Back pain prevalence in US industry and estimates of lost workdays. *Am J Public Health* 1999;89:1029–35.
7. Hashemi L, Webster BS, Clancy EA, et al. Length of disability and cost of workers' compensation low back pain claims. *J Occup Environ Med* 1997; 39:937–45.
8. Hashemi L, Webster BS, Clancy EA, et al. Length of disability and cost of work-related musculoskeletal disorders of the upper extremity. *J Occup Environ Med* 1998;40:261–9.
9. Webster BS, Snook SH. The cost of 1989 workers' compensation low back pain claims. *Spine* 1994;19:1111–6.
10. Williams DA, Feuerstein M, Durbin D, et al. Health care and indemnity costs across the natural history of disability in occupational low back pain. *Spine* 1998;23:2329–36.
11. Crook J, Milner R, Schultz IZ, et al. Determinants of occupational disability following a low back injury: a critical review of the literature. *J Occup Rehabil* 2002;12:277–95.
12. Pengel LHM, Herbert RD, Maher CG, et al. Acute low back pain: systematic review of its prognosis. *BMJ* 2003;327:323–7.
13. Steenstra IA, Verbeek JH, Heymans MW, et al. Prognostic factors for duration of sick leave in patients sick listed with acute low back pain: a systematic review of the literature. *Occup Environ Med* 2005;62:851–60.
14. Pincus T, Burton AW, Vogel S, et al. A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. *Spine* 2002;27:E109–E120.
15. Hilfiker R, Bachmann LM, Heitz C, et al. Value of predictive instruments to determine persisting restriction of function in patients with subacute nonspecific low back pain. Systematic review. *Eur Spine J* 2007;16:1755–75.
16. Turner JA, Franklin G, Fulton-Kehoe D, et al. Prediction of chronic disability in work-related musculoskeletal disorders: a prospective, population-based study. *BMC Musculoskelet Disord* 2004;5:14.
17. Turner JA, Franklin G, Fulton-Kehoe D, et al. Work recovery expectations and fear-avoidance predict work disability: a longitudinal, population-based study of workers' compensation back injury claimants. *Spine* 2006;31: 682–9.
18. Krause N, Frank JW, Dasinger LK, et al. Determinants of duration of disability and return-to-work after work-related injury and illness: challenges for future research. *Am J Ind Med* 2001;40:464–84.
19. Turner JA, Franklin G, Turk DC. Predictors of chronic disability in injured workers: a systematic literature synthesis. *Am J Ind Med* 2000;38:707–22.
20. Stover BD, Turner JA, Franklin G, et al. Factors associated with early opioid prescription among workers with low back injuries. *J Pain* 2006;7:718–25.
21. Hosmer DW, Lemeshow S. *Applied Logistic Regression*. 2nd ed. New York, NY: John Wiley; 2000.
22. Steyerberg EW, Harrell FE, Borsboom GJJM, et al. Internal validation of predictive models: efficiency of some procedures for logistic regression analysis. *J Clin Epidemiol* 2001;54:774–81.
23. Roland M, Morris R. A study of the natural history of back pain. Part 1: Development of a reliable and sensitive measure of disability in low-back pain. *Spine* 1983;8:141–4.
24. Ware JE, Kosinski M, Dewey JE. *How to Score Version Two of the SF-36 Health Survey*. Lincoln, RI: Quality Metric; 2000.
25. Lotters F, Burdorf A. Prognostic factors for duration of sickness absence due to musculoskeletal disorders. *Clin J Pain* 2006;22:212–21.
26. van der Weide WE, Verbeek J, Salle J, et al. Prognostic factors for chronic disability from acute low-back pain in occupational health care. *Scand J Work Environ Health* 1999;25:50–6.
27. Schultz IZ, Crook JM, Berkowitz J, et al. Biopsychosocial multivariate predictive model of occupational low back disability. *Spine* 2002;27: 2720–5.
28. Fransen M, Woodward M, Norton R, et al. Risk factors associated with the transition from acute to chronic occupational back pain. *Spine* 2002;27: 92–8.
29. McIntosh G, Frank J, Hogg-Johnson S, et al. Prognostic factors for time receiving workers' compensation benefits in a cohort of patients with low back pain. *Spine* 2000;25:147–57.
30. Infante-Rivard C, Lortie M. Prognostic factors for return to work after a first compensated episode of back pain. *Occup Environ Med* 1996;53:488–94.
31. Krause N, Dasinger LK, Deegan LJ, et al. Psychosocial job factors and return-to-work after compensated low back injury: a disability phase-specific analysis. *Am J Ind Med* 2001;40:374–92.
32. Mahmud MA, Webster JS, Courtney TK, et al. Clinical management and the duration of disability for work-related low back pain. *J Occup Environ Med* 2000;42:1178–87.
33. Loisel P, Vachon B, Lemaire J, et al. Discriminative and predictive validity assessment of the Quebec Task Force Classification. *Spine* 2002;27: 851–7.
34. Crook J, Moldofsky H, Shannon H. Determinants of disability after a work related musculoskeletal injury. *J Rheumatol* 1998;25:1570–7.
35. Leveille SG, Ling S, Hochberg MC, et al. Widespread musculoskeletal pain and the progression of disability in older disabled women. *Ann Intern Med* 2001;135:1038–46.
36. Natvig B, Eriksen W, Bruusgaard D. Low back pain as a predictor of long-term work disability. *Scand J Public Health* 2002;30:288–92.
37. Gureje O, Simon GE, Von Korff M. A cross-national study of the course of persistent pain in primary care. *Pain* 2001;92:195–200.
38. Sharma R, Haas M, Stano M. Patient attitudes, insurance, and other determinants of self-referral to medical and chiropractic physicians. *Am J Public Health* 2003;93:2111–7.
39. Nyiendo J, Haas M, Goldberg B, et al. Pain, disability, and satisfaction outcomes and predictors of outcomes: a practice-based study of chronic low back pain patients attending primary care and chiropractic physicians. *J Manipulative Physiol Ther* 2001;24:433–9.
40. Hogg-Johnson S, Cole DC. Early prognostic factors for duration on temporary total benefits in the first year among workers with compensated occupational soft tissue injuries. *Occup Environ Med* 2003;60:244–53.
41. Okurowski L, Pransky G, Webster B, et al. Prediction of prolonged work disability in occupational low-back pain based on nurse case management data. *J Occup Environ Med* 2003;45:763–70.
42. Shaw WS, Pransky G, Fitzgerald TE. Early prognosis for low back disability: intervention strategies for health care providers. *Disabil Rehabil* 2001;23: 815–28.
43. Gatchel RJ, Peng YB, Peters ML, et al. The biopsychosocial approach to chronic pain: scientific advances and future directions. *Psychol Bull* 2007; 133:581–624.

44. Manek NJ, MacGregor AJ. Epidemiology of back disorders: prevalence, risk factors, and prognosis. *Curr Opin Rheumatol* 2005;17:134–40.
45. Valat JP, Goupille P, Vedere V. Low back pain: risk factors for chronicity. *Rev Rhum Engl Ed* 1997;64:189–94.
46. Fordyce WE. On the nature of illness and disability. *Clin Orthop* 1997;336: 47–51.
47. Blyth FM, Macfarlane GJ, Nicholas MK. The contribution of psychosocial factors to the development of chronic pain: the key to better outcomes for patients? *Pain* 2007;129:8–11.
48. Wyatt SB, Winters KP, Dubbert PM. Overweight and obesity: prevalence, consequences, and causes of a growing public health problem. *Am J Med Sci* 2006;331:166–74.
49. Christakis NA, Fowler JH. The spread of obesity in a large social network over 32 years. *N Engl J Med* 2007;357:370–9.
50. Berkman LF. Introduction: seeing the forest and the trees-from observation to experiments in social epidemiology. *Epidemiol Rev* 2004;26:2–6.
51. Von Korff M, Ormel J, Keefe FJ, et al. Grading the severity of chronic pain. *Pain* 1992;50:133–49.
52. Bush K, Kivlahan DR, McDonell MB, et al. The AUDIT Alcohol Consumption Questions (AUDIT-C): an effective brief screening test for problem drinking. *Arch Intern Med* 1998;158:1789–95.
53. Hazard RG, Haugh LD, Reid S, et al. Early prediction of chronic disability after occupational low back injury. *Spine* 1996;21:945–51.
54. Sullivan MJL, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. *Psychol Assess* 1995;7:524–32.
55. Waddell G, Newton M, Henderson I, et al. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain* 1993;52:157–68.

APPENDIX 4

Health Maintenance Care in Work-Related Low Back Pain and Its Association With Disability Recurrence

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Objectives: To compare occurrence of repeated disability episodes across types of health care providers who treat claimants with new episodes of work-related low back pain (LBP). **Method:** A total of 894 cases followed 1 year using workers' compensation claims data. Provider types were defined for the initial episode of disability and subsequent episode of health maintenance care. **Results:** Controlling for demographics and severity, the hazard ratio [HR] of disability recurrence for patients of physical therapists (HR = 2.0; 95% confidence interval [CI] = 1.0 to 3.9) or physicians (HR = 1.6; 95% CI = 0.9 to 6.2) was higher than that of chiropractor (referent, HR = 1.0), which was similar to that of the patients non-treated after return to work (HR = 1.2; 95% CI = 0.4 to 3.8). **Conclusions:** In work-related nonspecific LBP, the use of health maintenance care provided by physical therapist or physician services was associated with a higher disability recurrence than in chiropractic services or no treatment.

Low back pain (LBP) continues to be one of the costliest work-related injuries in the United States in terms of disability and treatment costs.[1,2] An additional, important component of the human and economic costs is the recurrence of LBP.[3] Recurrences of LBP are complex to study because of the difficulty in predicting recurrence and the varying definitions and measurements of recurrence.[4–9] So far, there has been little success in preventing recurrent LBP with few studies to investigate this topic. More evidence is needed to understand recurrent LBP and justify interventions to prevent recurrence.

Health maintenance care is a clinical intervention approach thought to prevent recurrent episodes of LBP. It conceptually refers to the utilization of health care services with the aim of improving health status and preventing recurrences of a previous health condition. Breen's original definition of health maintenance care[10,11] refers to "treatment... after optimum recorded benefit was reached." The definition of *optimum* is subject to interpretation, making it difficult to clearly distinguish curative treatment from health maintenance; it blends the public health concepts of secondary prevention (treatment and prevention of recurrences) with tertiary prevention (obtaining the best health condition while having an incurable disease).[10] Health maintenance care can include providing advice, information, counseling, and specific physical procedures.[10–12] Health maintenance care is predominantly and explicitly recommended by chiropractors, although some physical therapists also advocate health maintenance procedures to prevent recurrences.[12] Physicians do not use this terminology when assisting a patient that has reached an optimum level.

There have been few scientific studies to evaluate the effectiveness of health maintenance care. A 2008 review found only 13 eligible citations and did not arrive at any conclusion about its effectiveness, and the operational definitions of health maintenance care were vague at best.[10] None of these citations referred to work-related LBP.

In the occupational health field, sustained return-to-work is considered an important goal during injury recovery. Given the patient's condition and context, going back out of work is considered an appropriate measurement of a recurrent condition because it reflects the non-sustainability of working and implies a failure of the return-to-work process. However, it is possible that different providers focus more on return to work (eg, chiropractors) than others (eg, physicians that could focus more on pain control). An association between specific type(s) of treatment or providers and significant recurrence of a condition (measured as recurrent work disability) could imply an important advancement in the treatment of work-related back injuries.

Work-related LBP is often treated by a combination of providers, including chiropractors, physical therapists, and physicians. Given that chiropractors are proponents of health maintenance care, we hypothesize that patients with work-related LBP who are treated by chiropractors would have a lower risk of recurrent disability because that specific approach would be used. Conversely, similar patients treated by other providers would have higher recurrence rates because the general approach did not include maintaining health, which is a key concept to prevent recurrence. Unfortunately, there is no available data that could allow direct characterization of which procedures were specifically product of the health maintenance care approach. Therefore, the present study aims to study the association between provider type during the initial period of return to work and risk of recurrence of disability due to work-related LBP.

METHODS

Study Population

After institutional review board approval, data were extracted from the administrative records of a large insurance company that represents approximately 10% of the US workers' compensation with coverage to a broad array of states, industries, and company sizes. Claims filed in Illinois, Massachusetts, Maryland, New Hampshire, New York, Texas, and Wisconsin between January 1, 2006, and December 31, 2006, were reviewed because claimants in these states can choose the provider they prefer to see for a work-related injury.[13] A total of 11,420 nonspecific LBP cases were identified by body part (lower back, sacrum, coccyx, or multiple trunk) and nature of injury (sprain or strain) codes. All claimants were followed from the date of injury until 12 months after the first episode of disability. Claimants who did not receive any paid disability were excluded ($n = 7552$). To capture new episodes of LBP cases, claimants who filed a workers' compensation claim in the prior year were identified by using the same LBP identification criteria and excluded ($n = 227$).[14,15]

Temporary total disability compensation information, defined as the worker completely unable to work on a temporary basis due to health related impairment, for each claimant was used to determine the beginning, end, and duration of each disability episode and health maintenance care period (Fig. 1). The health maintenance care period of interest was defined as the period after the initial disability episode had ended and the person had returned to work for more than 14 days. Temporary partial disability periods, defined as the worker returning

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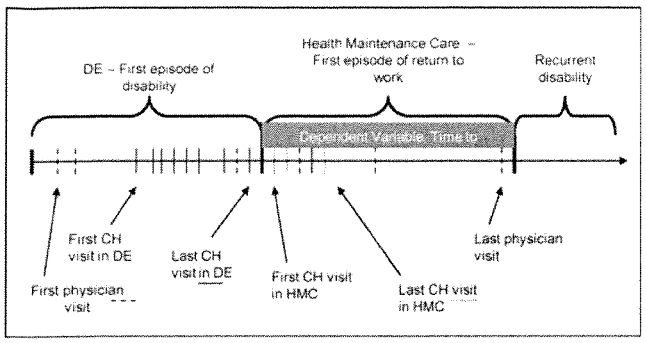

FIGURE 1. Graphic representation of the beginning, end, and duration of each disability episode and health maintenance care period.

to work but on an alternate duty job, usually part time with lower wages, were defined as periods where the claimant was working and were included in the health maintenance care periods. *Recurrent disability* was defined as a resumption of temporary total disability compensation after an episode of health maintenance care. If the first disability episode was 7 days or less, the claimant was excluded from the data set ($n = 755$) because there is a waiting period for disability compensation of up to 7 days that varies by state. Including these claimants with 7 days or less of disability would have introduced misclassification in the measure of disability duration. If the health maintenance care period was 7 days or less, it was assumed that the person was not truly ready to be back at work, and this period was included in the initial disability episode that bounded it. Claimants with a health maintenance care period between 8 and 14 days were excluded from the study cohort under the assumptions that it is not likely that the actual pattern of service utilization during this period could have been properly determined in such short time period ($n = 69$).

To obtain a homogeneous study population, additional cases were excluded according to the following criteria: (1) More than one injury date was reported for the same claim (19 excluded); (2) The first disability episode began more than 7 days after the injury occurred, which ensured that all cases shared similar severity/complexity with respect to requirements for work disability within the first week after the injury (652 excluded); (3) The claimant had fewer than four physical therapy or chiropractic visits during the disability episode period, which could have resulted in improper characterization of disability episode period treatment because of unstable numbers (1182 excluded); (4) The claimant was younger than 17 or older than 65 years old (13 excluded); (5) The first medical visit occurred more than 14 days after the injury occurred, which implies a retroactive evaluation of work causality where cases could have received some type of treatment not included in claim bills, causing misclassification of received health care (33 excluded); (6) During first medical visit, none of the diagnoses was related to LBP (18 excluded); (7) The follow-up of the health maintenance care period was less than 1 year when censored at July 31, 2008 (73 excluded). (8) Incomplete data (two excluded). The final study cohort was composed of 894 cases.

Measurements

Exposure Variable: Provider Type During Health Maintenance Care Period.

An algorithm, based on standard medical procedure (current procedural terminology), provider, and other company-specific provider codes, was designed and implemented to designate each visit as *physical therapy*, *chiropractic*, or *physician* services. Given that each patient could utilize any combination of physical therapy, chiropractic, and/or physician visit(s), the provider for which the patient sought care for more than 50% of visits defined the *provider type*. Cases who did not receive health care during the health maintenance care period or who could not be properly classified were also included as separate groups (Table 1).

Provider type during disability episode period was used as a sensitivity analysis. With the same purpose, we defined separate groups for *preferred provider type during both periods* to account for potential changes in the provider type between disability episode and health maintenance care (Table 1).

Outcome Variable

Time-to-disability-recurrence was the outcome variable. This was defined as the number of days between the first day of returning to work for at least 15 consecutive days after the initial disability episode until the day before recurrence of disability. *Recurrent disability* was defined as the resumption of at least 15 consecutive days of temporary total disability payments following the health maintenance care period.

Covariates

Demographic variables were age, gender, and job tenure. *Severity* was measured using a modified classification system developed by Krause et al.[16] Cases were assigned to the high severity group, if they received any medical service with an *International Classification of Diseases, 9th Edition*, diagnostic code compatible with radiculopathy, spinal stenosis, instability, or sequelae of prior back surgery within the first 2 weeks after injury, and to the low severity group in the absence of any of these codes.[15] The following variables were also included as proxies of initial severity: *Comorbidity* was defined as the presence or absence of any non-LBP diagnosis reported during the first 15 days after the onset of the claim (previously described as a confounder of the association between provider type and LBP recurrence[17]); surgery during disability episode or health maintenance care periods (two cases had surgery during health maintenance care period); and opioid use (yes/no), average weekly treatment cost for disability episode and health maintenance care periods, and duration of the initial episode of disability.

Because worker's compensation in the United States is regulated at the state level, state of jurisdiction was also included. Using claim information to describe job title, occupation was manually coded using the O*NET 13 database, which allowed job-level working conditions to be attributed to each case using exposure algorithms designed and validated in previous studies.[18–21] Job-level physical and psychosocial indicators of exposure were obtained for most job titles in the sample (92 cases [10.3%] could not be coded). In addition, occupations were grouped into O*NET job families according to O*NET Web page at http://online.onetcenter.org/find/.

Analysis

Descriptive statistics for severity indicators were compared for each type of exposure measure. Exposure measures and categorical covariates were also compared for presence of recurrent disability.

Cox regression models were used to estimate the association between exposure (referent group: those identified as only or mostly visiting a chiropractor) with time-to-disability recurrence after controlling for potential confounders. To be considered a confounder, a covariate had to change the exposure coefficient by at least 15% of its value after its inclusion in the original hazard regression model. A series of three nested multivariate models was created in a stepwise forward manner. First, the exposure variable was included as the only predictor in the model; then, demographic indicators were

TABLE 1. Operational Definitions of Health Care Utilization and Distribution of the Sample by Type of Provider

Variable	Categories	Definition	Number of Cases: Disability Episode (Percent of Total)	Number of Cases: Health Care Maintenance (Health Maintenance Care) Episode (Percent of Total)
Type of provider during specific period (either disability episode or health maintenance care)	Only or mostly chiropractor	Only or mostly visits to a chiropractor	242 (27%)	184 (21%)
	Only or mostly physical therapy	Only or mostly visits to a physical therapist	428 (48%)	213 (24%)
	Only or mostly physician	Only or mostly visits to other medical provider (non-chiropractor and non-physical therapist)	102 (11%)	273 (31%)
	Chiropractor and physical therapy combined	Not included in previous categories, but have >4 visits to chiropractor and/or more than 4 visits to physical therapist	62 (7%)	47 (5%)
	Any other combination	All of those not included in any previous categories, includes balanced combinations of physical therapy and physician or chiropractor and physician or all three of them.	60 (7%)	31 (4%)
	No health maintenance care	Had some type of treatment during disability episode and did not have chiropractor, physical therapist, or any other type of medical visit during the health maintenance care	–	146 (16%)
Continued relationship with the provider from the first disability episode to the health maintenance care called preferred type of provider	Chiropractor loyalist	Only or mostly visits to a chiropractor during the disability episode and the health maintenance care	159 (18%)	
	Physical therapy loyalist	Only or mostly visits to a physical therapist during the disability episode and the health maintenance care	158 (18%)	
	Physician loyalist	Only or mostly visits to other medical provider (non-chiropractor and non-physical therapist) during the disability episode and the health maintenance care	54 (6%)	
	Physical therapy to physician	Only or mostly physical therapy during the disability episode and only or mostly other medical provider during the health maintenance care	159 (18%)	
	Switchers	Switch from one only/mostly category during the disability episode to another only/mostly category during the health maintenance care	55 (6%)	
	Any other combination	All of those not included in any previous categories. Includes only or mostly chiropractor moving to other groups (60), physical therapy to non-physician groups (29), physician to other groups (26), chiro and physical therapy combined to other or same groups (58), and any other combination to any other group or the same group (45).	163 (18%)	
	No health maintenance care	Had some type of treatment during disability episode and did not have chiropractor, physical therapist, or any other type of medical visit during the health maintenance care	146 (16%)	

added; and finally, severity indicators were included. Only those variables that were significant or identified as confounders for the next step were kept in the nested model that followed. To prevent bias due to improper case-mix adjustment, the association between the covariate and the outcome was checked to ensure that it did not vary across the exposure categories.[22] Those variables with varying association levels across exposure categories were excluded from the final model. SAS 9.2 (SAS, Inc, Cary, NC) was used to analyze the data.

RESULTS

Our cohort consisted of 894 cases with a median age of 41 years (interquartile range [IQR] = 33 to 49), among whom 32% were women. The median job tenure was 2 years (IQR = 0.0 to 7.0). The most frequent O*NET job families were transportation and material moving (29.1%), production (12.8%), office and administrative support (9.6%), and building and ground cleaning (6.0%). New York (27.0%), Texas (20.4%), and Illinois (18.1%) were the states with the largest contribution to the sample.

Table 1 describes the frequency and proportion of the study cohort for the operational definitions of health care utilization during disability episode, the health maintenance care period, and both combined. During disability episode, the largest group was only or mostly visits to a physical therapist (48%), followed by only or mostly visits to a chiropractor (27%). During the health maintenance care period, the largest group was only or mostly visits to physician (31%) followed by only or mostly visits to physical therapist (24%) and only or mostly visits to chiropractor (21%). Sixteen percent received no medical care during the health maintenance care period.

Provider Type and Severity Indicators

Table 2 shows the frequency and proportion of each exposure category that were positively classified for each of the severity indicators. In general, except for the severity based on *International Classification of Diseases, 9th Edition*, those cases treated by chiropractors consistently tended to have a lower proportion in each of the categories for severity proxy compared to the other groups; fewer used opioids and had surgery. In addition, people who were mostly treated by chiropractor had, on average, less expensive medical services and shorter initial periods of disability than cases treated by other providers.

Covariates, Exposure Measures, and Disability Recurrence

Almost a tenth (11%) of the cohort experienced recurrent disability because of work-related LBP ($n = 98$). Among the continuous covariates, job tenure was higher in the group with no disability recurrence (5.5 vs 3.6 years). The average weekly treatment costs during disability episode was $122 higher for those who had recurrent disability in comparison to those who did not ($565 vs $444, $P = 0.0019$) and $318 higher during health maintenance care ($371 vs $53, $P < 0.0001$). Duration of initial length of disability and all O*NET continuous covariates were not significantly associated with recurrent disability.

Among the categorical covariates (Table 3), the proportion of those with recurrent disability was significantly different between states of jurisdiction ($P = 0.0013$). Having received at least one opioid prescription during disability episode was not associated with having recurrent disability (10.1% among non–opioid users vs 14.1% among opioid users, $P = 0.1227$), but having received opioids during the health maintenance care period was significantly associated with recurrent disability (9.5% vs 21.6%, $P = 0.0001$).

Provider type during the health maintenance care period was significantly associated with recurrent disability ($P = 0.0053$) with the only or mostly physical therapy group having the highest proportion of recurrent disability (16.9%) and the only or mostly chiropractor and the no health maintenance care groups having the lowest proportion of recurrent disability (6.5% and 5.5%, respectively). In sensitivity analyses, provider type during the disability episode was not significantly associated with recurrent disability ($P = 0.0650$). The provider type of both periods combined is also significantly associated with recurrent disability ($P = 0.0056$), with physician loyalists having the highest proportion of recurrent disability (16.7%) and those receiving no health maintenance care or being chiropractor loyalist having the lowest proportion of disability recurrence (5.5% and 5.7%, respectively).

Crude estimates for mean duration at work after the initial period of disability and before the recurrence were 345 (95% confidence interval [CI] = 334 to 356) days for only or mostly chiropractor during health maintenance care period, 316 (95% CI = 301 to 331) days for only or mostly physical therapy patients, and 316 (301, 331) days for only or mostly physician cases.

MULTIVARIATE SURVIVAL MODELS

Provider Type During Health Maintenance Care Period

During the health maintenance care period using unadjusted and adjusted Cox regression analysis (Table 4), a trend is seen where the hazard ratios [HRs] of disability recurrence are generally higher for the only or mostly physical therapy and only or mostly physician groups than for the only or mostly chiropractor group (referent). However, after controlling for demographics and severity indicators just the only or mostly physical therapy group remains with a higher HR (models 3 and 4). The no health maintenance care group does not have any statistically significant difference with the only or mostly chiropractor group.

EVALUATING ALTERNATIVE CATEGORIZATIONS OF EXPOSURE

Provider Type During Disability Episode

Provider type during disability episode was associated with the hazard of disability recurrence after returning to work. Compared with the only or mostly chiropractor (referent), the groups of only or mostly physical therapy and only or mostly physician had significantly higher HRs (2.0 and 2.7 respectively, model 1). After controlling for significant demographic variables (model 2), there was a slight attenuation in some HRs. After adding severity indicators (models 3), the HRs were slightly higher than the unadjusted model.

Preferred Provider Type

After controlling for demographics and severity, compared with the "chiropractor loyalist" group (referent), the "physical therapist loyalist" group had a significantly higher HR (model 3). The no health maintenance care group does not have any statistically significant difference with the chiropractor loyalist group.

The only covariate that had varying association with the outcome variable across the exposure measurements was state of jurisdiction. Therefore, a series of fully controlled models that excluded state of jurisdiction was run (model 4). Model 4 tended to have a similar or better fit than the full model that included state (model 3) and the differential effect of provider type over recurrent disability increased in the same direction as the previous models.

DISCUSSION

A cohort of 894 patients suffering work-related LBP was followed from their first episode of disability through their subsequent return-to-work (health maintenance care period). A tenth of them had recurrent disability due to LBP. After controlling for demographic and severity factors, compared with receiving treatment

TABLE 2. Frequency of Severity Indicators by Categories of Exposure

Exposure Categories (n)	ICD-9 Diagnosis Based Injury Severity (High), n (%)	Presence of Comorbidity During the First 15 Days of Disability Episode, n (%)	Surgery During Disability Episode or Health Maintenance Care Periods, n (%)	Opioid Use During Disability Episode, n (%)	Duration (days) of First Episode of Disability, Mean (Median)	Opioid Use During Health Maintenance Care Period, n (%)	Weekly Average Cost of Medical Expenses during Health Maintenance Care Period (US$), Mean (IQR)	Weekly Average Cost of Medical Expenses during Disability Episode (US$), Mean (IQR)
Type of provider during health maintenance care period								
Only or mostly chiropractor (184)	98 (53.3)	28 (15.2)	1 (0.5)	25 (13.6)	49 (33)	15 (8.1)	48 (9–58)	371 (179–471)
Only or mostly physical therapy (213)	84 (39.4)	42 (19.7)	10 (4.7)	43 (20.2)	58 (42)	24 (11.3)	129 (13–134)	543 (287–664)
Only or mostly physician (273)	113 (41.4)	49 (18.0)	14 (5.1)	84 (30.8)	119 (89)	54 (19.8)	87 (6–84)	470 (245–588)
Chiropractor and physical therapy combined (47)	31 (66.0)	7 (14.9)	1 (2.1)	7 (14.9)	62 (36)	11 (23.4)	207 (66–203)	367 (220–462)
Any other combination (31)	13 (41.9)	4 (12.9)	0 (0.0)	7 (22.6)	73 (49)	4 (12.9)	50 (7–57)	428 (255–446)
No HM (146)	48 (32.9)	21 (14.4)	4 (2.7)	18 (12.3)	84 (54)	3 (2.1)	18 (1–2)	451 (197–528)
Type of provider during disability episode								
Only or mostly chiropractor (242)	138 (57.0)	40 (16.5)	2 (0.8)	31 (12.8)	56 (33)	22 (9.1)	74 (9–64)	368 (174–473)
Only or mostly physical therapist (428)	136 (31.8)	60 (14.0)	9 (2.1)	80 (18.7)	74 (50)	45 (10.5)	79 (5–82)	452 (249–581)
Only or mostly physician (102)	52 (50.1)	28 (27.5)	15 (14.7)	44 (43.1)	141 (128)	25 (24.5)	121 (17–146)	643 (246–768)
Chiropractor and physical therapy combined (62)	40 (64.5)	9 (14.5)	3 (4.8)	17 (27.4)	133 (102)	12 (19.4)	142 (23–135)	497 (281–652)
Any other combination (60)	21 (35.0)	14 (23.3)	1 (1.7)	12 (20.0)	57 (42)	7 (11.7)	139 (5–60)	491 (242–553)
Preferred type of provider (both periods combined)								
Chiro loyalist (159)	86 (54.1)	27 (17.0)	0 (0.0)	17 (10.7)	43 (28)	11 (6.9)	45 (8–55)	370 (174–469)
Physical therapy loyalist (158)	49 (31.0)	26 (16.5)	5 (3.2)	27 (17.1)	50 (39)	13 (8.2)	92 (11–104)	486 (272–656)
Physician loyalist (54)	26 (48.2)	16 (29.6)	7 (13.0)	26 (48.2)	171 (150)	18 (33.3)	126 (26–158)	589 (231–798)
Physical therapy to physician (159)	55 (34.6)	22 (13.8)	4 (1.9)	38 (23.9)	100 (77)	24 (15.1)	67 (3–63)	433 (244–579)
Switchers and other combination of provider (218)	123 (56.4)	39 (17.9)	11 (5.1)	58 (26.6)	88 (57)	42 (19.3)	147 (19–144)	488 (247–571)
No health maintenance care (146)	48 (32.9)	21 (14.4)	4 (2.7)	18 (12.3)	84 (54)	3 (2.1)	18 (1–2)	451 (197–582)

ICD-9 indicates International Classification of Diseases, 9th Edition; IQR, Interquartile range; HM, health maintenance.

TABLE 3. Distribution of Exposure Measures and Categorical Covariates and Their Association with Recurrent Disability within 1 Year of the Onset of the *Health Maintenance Care* Period.

		Total in the Category		Percent With Recurrent Disability	Chi-Square (*P* Value)
Type of provider during health maintenance care	No health maintenance care	146	(16%)	5.5	16.6 (0.0053)
	Only or mostly chiropractor	184	(21%)	6.5	
	Only or mostly physical therapy	213	(24%)	16.9	
	Only or mostly physician	273	(31%)	12.5	
	Chiropractor and physical therapy combined	47	(5%)	10.6	
	Various mixes	31	(4%)	9.7	
Type of provider during disability Episode	Only or mostly chiropractor	242	(27%)	6.2	8.8 (0.0650)
	Only or mostly physical therapy	428	(48%)	12.2	
	Only or mostly physician	102	(11%)	15.7	
	Chiropractor and physical therapy Combined	62	(7%)	12.9	
	Various mixes	60	(12%)	11.7	
Preferred type of provider	Chiropractor loyalist	159	(18%)	15.8	16.5 (0.0056)
	Physical therapy loyalist	158	(6%)	16.7	
	Physician loyalist	54	(18%)	10.7	
	Physical therapy to physician	159	(24%)	13.8	
	Switchers and others	218	(18%)	5.7	
	No health maintenance care	146	(16%)	5.5	
Gender	Women	286	(32%)	12.9	1.7 (0.1948)
	Men	608	(68%)	10.0	
Job family (O*NET)	Transportation and material moving	234	(29%)	13.3	14.4 (0.8091)
	Architecture and engineering	3	(0.4%)	0.0	
	Arts, design, entertainment, sports	4	(0.5%)	25.0	
	Building and grounds cleaning	48	(6%)	18.8	
	Business and financial operations	4	(0.5%)	0.0	
	Community and social services	6	(0.8%)	0.0	
	Computer and mathematical	1	(0.1%)	0.0	
	Construction and extraction	61	(8%)	4.9	
	Education, training, and library	8	(1%)	12.5	
	Farming, fishing, and forestry	2	(0.2%)	0.0	
	Food preparation and serving	34	(4%)	8.8	
	Health care practitioners and tech	29	(4%)	10.3	
	Health care support	47	(5%)	10.6	
	Installation, maintenance, repair	64	(8%)	6.3	
	Life, physical, and social science	3	(0.4%)	0.0	
	Management	19	(2%)	10.5	
	Office and administrative support	77	(10%)	15.6	
	Personal care and service	20	(2%)	10.0	
	Production	103	(13%)	9.7	
	Protective service	7	(1%)	0.0	
	Sales and related	31	(4%)	16.1	
Disability episode-health maintenance care surgery	No surgery	864	(97%)	11.0	0.03 (0.8638)
	Yes	30	(3%)	10.0	
Opioid use during disability episode	No	710	(79%)	10.1	2.4 (0.1227)
	Yes	184	(21%)	14.1	
Opioid use during health maintenance care	No	783	(88%)	9.5	14.8 (0.0001)
	Yes	111	(12%)	21.6	
Comorbidity within the first 15 days of disability episode	No	743	(83%)	11.8	3.5 (0.0612)
	Yes	151	(17%)	6.6	
Clinical severity	Low severity	507	(57%)	10.9	0.02 (0.9008)

(*Continues*)

TABLE 3. (*Continued*)

		Total in the Category		Percent With Recurrent Disability	Chi-Square (*P* Value)
	High severity	387	(43%)	11.1	
State	Illinois	162	(18%)	13.6	21.8 (0.0013)
	Massachusetts	97	(11%)	7.2	
	Maryland	50	(6%)	18.0	
	New Hampshire	39	(4%)	12.8	
	New York	241	(27%)	8.3	
	Texas	182	(20%)	7.7	
	Wisconsin	123	(14%)	13.0	

TABLE 4. Hazard Ratios for Time to Disability Recurrence by Type of Provider (uncontrolled to fully controlled models).

	Model 1—Hazard ratios (95% CI)	Model 2—Controlling for State of Jurisdiction and Job Tenure (95% CI)	Model 3—Controlling for State of Jurisdiction, Job Tenure, Opioid Use During Health Maintenance Care Period, Average Weekly Treatment Cost for Health Maintenance Care Period and Disability Episode Period, Model Comorbidity, Clinical Severity (95% CI)	Model 4—Similar to Model 3 but Excluding State of Jurisdiction (95% CI)
Type of provider during health maintenance care period				
Model fit (AIC)	1314.3	1307.6	1169.5	1170.5
Only or mostly chiropractic	1.0	1.0	1.0	1.0
Only or mostly physical therapy	2.7 (1.4–5.2)	2.3 (1.2–4.5)	2.0 (1.1–3.9)	2.4 (1.2–4.7)
Only or mostly physician	2.0 (1.1–3.7)	1.7 (0.9–3.4)	1.6 (0.8–3.1)	1.7 (0.9–3.4)
Chiropractor and physical therapy combined	1.6 (0.6–4.6)	1.8 (0.6–5.1)	0.4 (0.1–1.7)	0.4 (0.1–1.7)
Any other combination	1.5 (0.4–5.2)	1.2 (0.3–4.3)	1.2 (0.3–4.3)	1.5 (0.4–5.2)
No health maintenance care	0.8 (0.4–2.1)	0.7 (0.3–1.8)	1.2 (0.4–3.8)	1.4 (0.4–4.3)
Alternative categorizations of exposure				
Type of provider during disability episode				
Model fit (AIC)	1319.4	1312.1	1167.1	1168.3
Only or mostly chiropractor	1.0	1.0	1.0	1.0
Only or mostly physical therapy	2.0 (1.1–3.6)	1.7 (1.0–3.1)	2.3 (1.2–4.4)	2.8 (1.5–5.3)
Only or mostly physician	2.7 (1.3–5.4)	2.5 (1.2–5.2)	3.3 (1.5–7.1)	3.4 (1.5–7.4)
Chiropractor and physical therapy combined	2.2 (0.9–5.1)	2.3 (1.0–5.3)	2.3 (0.9–5.8)	2.5 (1.0–6.1)
Any other combination	2.0 (0.8–4.8)	1.9 (0.8–4.6)	1.6 (0.5–4.7)	1.8 (0.6–5.2)
Preferred type of provider				
Model fit (AIC)	1314.3	1306.8	1174.3	1175.9
Chiropractor loyalist (159)	1.0	1.0	1.0	1.0
Physical therapy loyalist (158)	2.9 (1.3–6.2)	2.3 (1.1–5.0)	2.1 (1.0–4.6)	2.7 (1.3–5.8)
Physician loyalist (54)	3.0 (1.2–7.7)	2.8 (1.1–7.3)	2.4 (0.9–6.2)	2.5 (1.0–6.4)
Physical therapy to physician switch (159)	1.9 (0.9–4.3)	1.7 (0.7–3.9)	1.6 (0.7–3.6)	1.8 (0.8–4.1)
Switchers and other mixes (218)	2.5 (1.2–5.3)	2.4 (1.1–5.0)	1.5 (0.7–3.3)	1.6 (0.7–3.5)
No health maintenance care (146)	1.0 (0.4–2.5)	0.8 (0.3–2.2)	1.2 (0.4–4.2)	1.5 (0.4–4.7)

CI indicates confidence interval; AIC, Akaike Information Criteria.

only or mostly by chiropractors during the health maintenance care period, receiving treatment by physical therapists, physicians, or a combination of both tended to result in significantly higher HRs of recurrent disability. Similarly, when compared to patients treated only or mostly by chiropractors during the disability episode or patients who were "chiropractor loyalists" during transition from the disability episode to the health maintenance care period, patients treated by other care providers tended to have a higher hazard of recurrent disability.

In our study, after controlling for demographics and severity indicators, the likelihood of recurrent disability due to LBP for recipients of services during the health maintenance care period by all other provider groups was consistently worse when compared with recipients of health maintenance care by chiropractors. Care from chiropractors during the disability episode ("curative"), during the health maintenance care period (main exposure variable, "preventive"), and the combination of both (curative and preventive) was associated with lower disability recurrence HRs.

This clear trend deserves some attention considering that chiropractors are the only group of providers who explicitly state that they have an effective treatment approach to maintain health.

Our findings should be viewed in the context of prior research. Few studies have addressed evaluating the effectiveness of health maintenance care.[10] Most of the reviewed studies found no clear advantage of any health maintenance approach or reported small benefits for the chiropractor maintenance care. A clinical trial found better disability indicators for patients exposed to spinal manipulation,[23] but no study compared work-related LBP recurrence rate across different providers. In 1999, Carey[17] found that in ambulatory general practice, the rate of recurrent disabling LBP was not significantly different at 6 months for chiropractors (8%), primary care physicians (9%), orthopedic surgeons (10%), and physicians and midlevel practitioners working as health maintenance organization staff (14%). The same nonsignificant results were observed at 22 months of follow-up. However, Carey's study did not consider time to recurrence and did not utilize a multivariate model, which might have provided different results.

SUGGESTED MECHANISM OF THE CHIROPRACTOR ADVANTAGE

Our results, which seem to suggest a benefit of chiropractic treatment to reduce disability recurrence, imply that if the benefit is truly coming from the chiropractic treatment, there is a mechanism through which care provided by chiropractors improves the outcome. It is always possible that unknown patient differences, which we were not able to control for, could be acting as unadjusted confounders and eventually explain the findings. With those caveats, we dare to speculate that for the purpose of preventing disability recurrence in cases of work-related LBP, the main advantage of chiropractors could be based on the dual nature of their practice. On one hand, it is the do-nothing approach: by visiting only or mostly a chiropractor or becoming a chiropractor loyalist, the patients do not receive other traditional medical approaches. In fact, there is a continuous struggle between chiropractors and orthopedic providers regarding the most basic principles that sustain each others' clinical practice.[24] There is a growing evidence that health-care-as-usual does not necessarily improve health outcomes in nonspecific LBP.[25,26] This hypothesis is supported by our finding that, after controlling for severity and demographics, no health maintenance care is generally as good as chiropractor care. Therefore, not as a conclusion but a hypothesis, chiropractors might be preventing some of their patients from receiving procedures of unproven cost utility value[27] or dubious efficacy.[25,26]

This argument has to be tempered by the fact that the most numerous group for a continued relationship with the provider (disability episode and health maintenance care) are the switchers (55 of them) and the any other combination (163 of them) groups, which together compose approximately 24% of the study group. The reasons why a small group of patients chose to switch or to combine providers during the health care maintenance period might be related to their good outcome, which is indistinguishable from the reference group. In others words, it may be possible that those switchers and any other combination groups for some reason knew what the best health care path was for them.

On the other hand, chiropractors argue that their aim is to provide care while being centered on the whole patient. It is possible that this approach provides more opportunities for a provider–patient relationship that improves communication, and likely emphasizes the importance of return to work over symptom control, and focuses on psychosocial issues that have been demonstrated to be important in the evolution of LBP disability.[28] Some of the important weakness of this hypothesis is the fact that we are attributing to a whole job title attributes that vary among individual providers. Do chiropractors truly emphasize in their practice relationship quality and communication? Do patients of non-chiropractor providers who focus on personal relationship and good communication have better health outcomes than those patients whose providers do not do so? Some studies seem to point in that direction.[29] In addition, it is important to state that this considered mechanism is not at all a chiropractor exclusivity and other care providers may similarly think along these lines. Naturalistic studies that focus on the actual experiences of the provider–patient relationships could help to test our proposed mechanisms.

Study Limitations

As shown in Table 2, the only or mostly chiropractor group during the disability episode and health maintenance care periods and "chiropractor loyalists" during both periods combined had fewer surgeries, used fewer opioids, and had lower costs for medical care than the other provider groups. Therefore, it is important to consider that the claim of more effective prevention of recurrent disability by chiropractors might be attributed to what has been called "case-mix" bias,[22,30] which may be caused by the differences between the patients that visit each provider type. Any provider treating less severe patients should have a lower risk for recurrent disability for its patients. After controlling for demographic and severity factors, only a small component of the lowest risk of recurrent disability for chiropractic patients was removed, and this group consistently had a significantly lower HR for recurrent disability than physical therapist–treated patients.

Prior research has not found a strong association between measures of LBP clinical severity and return-to-work outcomes.[31–34] Some LBP severity scores are not strongly associated with disability, and although we controlled for some clinical indicators of severity, our study did not include other important variables; for example, characteristics of previous LBP episodes; patterns of pain and impairments within the current LBP episode; health care system characteristics that divert more severely injured patients away from chiropractors (could result in better recurrence rates to that provider group); self-selection that places fully or almost fully recovered patients into health maintenance care (ie, chiropractors), while other patients seek care from providers focused on curative goals (ie, physical therapists and physicians). Therefore, the complexity of controlling for "case-mix" bias with this type of condition is a problematic link in all observational studies of this type, even among those studies that include biomedical data. In addition, we did not evaluate work-related psychosocial variables at the individual level (only at the job level with O*NET), which have been established as confounders or effect modifiers for the relationship between pain and disability.[33,35,36]

In workers' compensation, health maintenance care has a distinctive relevance because full health recovery is not considered a requirement for return to work.[37,38] Therefore, a person can return to work while still symptomatic. As a consequence, what is considered

to be health maintenance care by some in the occupational health field, because it occurs after the patient has returned to work, can just as easily be seen as the completion of curative treatment by others who considered that the worker was recovered just enough to return to work but not fully recovered to an optimum level as the traditional definition of health maintenance care requires. However, this operational definition of health maintenance care has the distinct advantage of having a precise temporal boundary of onset (the moment of return-to-work) and at least one clear outcome (presence or absence of disability recurrence). It is possible that health maintenance care for work-related injuries needs an updated definition.

Exposure misclassification might have played a role in wrongly identifying patients to the only or mostly physician group into the only or mostly physical therapy group as physical therapy visits (2 to 3 per week) typically occur more frequently than physician visit (1 to 2 every 2 weeks). The impact of this misclassification should not have affected the risk of disability recurrence in those who typically utilized chiropractic services might have averaged out the risk of recurrent disability for those who typically utilized physical therapy/physician services.

CONCLUSION

After controlling for demographic factors and multiple severity indicators, patients suffering nonspecific work-related LBP who received health services mostly or only from a chiropractor had a lower risk of recurrent disability than the risk of any other provider type. Even without an improvement in days until recurrent disability, our findings seem to support the use of chiropractor services, as chiropractor services generally cost less than services from other providers. If a lower rate of disability recurrence in work-related LBP cases for chiropractors holds as true, it is important to identify the mechanism of action.

REFERENCES

1. Murphy PL, Volinn E. Is occupational low back pain on the rise? *Spine (Phila Pa 1976)*. 1999;24:691–697.
2. Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. *Spine J*. 2008;8:8–20.
3. Wasiak R, Kim J, Pransky G. Work disability and costs caused by recurrence of low back pain: longer and more costly than in first episodes. *Spine (Phila Pa 1976)*. 2006;31:219–225.
4. Wasiak R, Pransky G, Verma S, Webster B. Recurrence of low back pain: definition-sensitivity analysis using administrative data. *Spine (Phila Pa 1976)*. 2003;28:2283–2291.
5. Wasiak R, Pransky GS, Webster BS. Methodological challenges in studying recurrence of low back pain. *J Occup Rehabil*. 2003;13:21–31.
6. Wasiak R, Verma S, Pransky G, Webster B. Risk factors for recurrent episodes of care and work disability: case of low back pain. *J Occup Environ Med*. 2004;46:68–76.
7. Wasiak R, Young AE, Dunn KM, et al. Back pain recurrence: an evaluation of existing indicators and direction for future research. *Spine (Phila Pa 1976)*. 2009;34:970–977.
8. Marras WS, Ferguson SA, Burr D, Schabo P, Maronitis A. Low back pain recurrence in occupational environments. *Spine (Phila Pa 1976)*. 2007;32:2387–2397.
9. Stanton TR, Latimer J, Maher CG, Hancock M. Definitions of recurrence of an episode of low back pain: a systematic review. *Spine (Phila Pa 1976)*. 2009;34:E316–E322.
10. Leboeuf-Yde C, Hestbaek L. Maintenance care in chiropractic—what do we know? *Chiropr Osteopat*. 2008;16:3.
11. Axen I, Rosenbaum A, Eklund A, et al. The Nordic maintenance care program—case management of chiropractic patients with low back pain: a survey of Swedish chiropractors. *Chiropr Osteopat*. 2008;16:6.
12. Pincus T, Vogel S, Breen A, Foster N, Underwood M. Persistent back pain—why do physical therapy clinicians continue treatment? A mixed methods study of chiropractors, osteopaths and physiotherapists. *Eur J Pain*. 2006;10:67–76.
13. Tanabe RP, Murray SM. *Managed Care and Medical Cost Containment in Workers' Compensation. A National Inventory, 2001–2002*. Cambridge, MA: Workers Compensation Research Institute; 2004:328.
14. Webster BS, Cifuentes M, Verma S, Pransky G. Geographic variation in opioid prescribing for acute, work-related, low back pain and associated factors: a multilevel analysis. *Am J Ind Med*. 2009;52:162–171.
15. Webster BS, Verma SK, Gatchel RJ. Relationship between early opioid prescribing for acute occupational low back pain and disability duration, medical costs, subsequent surgery and late opioid use. *Spine*. 2007;32:2127–2132.
16. Krause N, Rugulies R, Ragland DR, Syme SL. Physical workload, ergonomic problems, and incidence of low back injury: a 7.5-year prospective study of San Francisco transit operators. *Am J Ind Med*. 2004;46:570–585.
17. Carey TS, Garrett JM, Jackman A, Hadler N. Recurrence and care seeking after acute back pain: results of a long-term follow-up study. North Carolina Back Pain Project. *Med Care*. 1999;37:157–164.
18. Boyer J, Galizzi M, Cifuentes M, et al. Ergonomic and socioeconomic risk factors for hospital workers' compensation injury claims. *Am J Ind Med*. 2009;52:551–562.
19. Cifuentes M, Boyer J, Gore R, et al. Job strain predicts survey response in healthcare industry workers. *Am J Ind Med*. 2008;51:281–289.
20. Cifuentes M, Boyer J, Gore R, et al. Inter-method agreement between O*NET and survey measures of psychosocial exposure among healthcare industry employees. *Am J Ind Med*. 2007;50:545–553.
21. d'Errico A, Punnett L, Cifuentes M, et al. Hospital injury rates in relation to socioeconomic status and working conditions. *Occup Environ Med*. 2007;64:325–333.
22. Nicholl J. Case-mix adjustment in non-randomised observational evaluations: the constant risk fallacy. *J Epidemiol Community Health*. 2007;61:1010–1013.
23. Descarreaux M, Blouin JS, Drolet M, Papadimitriou S, Teasdale N. Efficacy of preventive spinal manipulation for chronic low-back pain and related disabilities: a preliminary study. *J Manipulative Physiol Ther*. 2004;27:509–514.
24. Fitzcharles MA. Is it time for rheumatologists to rethink the use of manual therapies? *J Rheumatol*. 2002;29:1117–1120.
25. Haldeman S, Dagenais S. What have we learned about the evidence-informed management of chronic low back pain? *Spine J*. 2008;8:266–277.
26. Haldeman S, Dagenais S. A supermarket approach to the evidence-informed management of chronic low back pain. *Spine J*. 2008;8:1–7.
27. Dagenais S, Roffey DM, Wai EK, Haldeman S, Caro J. Can cost utility evaluations inform decision making about interventions for low back pain? *Spine J*. 2009;9:944–957.
28. Shaw WS, Pransky G, Fitzgerald TE. Early prognosis for low back disability: intervention strategies for health care providers. *Disabil Rehabil*. 2001;23:815–828.
29. Dasinger LK, Krause N, Thompson PJ, Brand RJ, Rudolph L. Doctor proactive communication, return-to-work recommendation, and duration of disability after a workers' compensation low back injury. *J Occup Environ Med*. 2001;43:515–525.
30. Bjorkgren MA, Fries BE, Hakkinen U, Brommels M. Case-mix adjustment and efficiency measurement. *Scand J Public Health*. 2004;32:464–471.
31. Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain*. 1993;52:157–168.
32. Thelander U, Fagerlund M, Friberg S, Larsson S. Describing the size of lumbar disc herniations using computed tomography. A comparison of different size index calculations and their relation to sciatica. *Spine (Phila Pa 1976)*. 1994;19:1979–1984.
33. Takahashi N, Kikuchi S, Konno S, et al. Discrepancy between disability and the severity of low back pain: demographic, psychologic, and employment-related factors. *Spine (Phila Pa 1976)*. 2006;31:931–939; discussion 940.
34. Michel A, Kohlmann T, Raspe H. The association between clinical findings on physical examination and self-reported severity in back pain. Results of a population-based study. *Spine (Phila Pa 1976)*. 1997;22:296–303; discussion 303–304.
35. Hoogendoorn WE, Bongers PM, de Vet HC, et al. Psychosocial work characteristics and psychological strain in relation to low-back pain. *Scand J Work Environ Health*. 2001;27:258–267.
36. Ghaffari M, Alipour A, Farshad AA, Jensen I, Josephson M, Vingard E. Effect of psychosocial factors on low back pain in industrial workers. *Occup Med (Lond)*. 2008;58:341–347.
37. Lotters F, Hogg-Johnson S, Burdorf AE. Health status, its perceptions, and effect on return to work and recurrent sick leave. *Spine (Phila Pa 1976)*. 2005;30:1086–1092.
38. Young AE. Employment maintenance and the factors that impact it after vocational rehabilitation and return to work. *Disabil Rehabil*. 2010;32:1621–1632.

APPENDIX 5

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Early Predictors of Lumbar Spine Surgery after Occupational Back Injury: Results from a Prospective Study of Workers in Washington State

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Abstract

Study Design—Prospective population-based cohort study

Objective—To identify early predictors of lumbar spine surgery within 3 years after occupational back injury

Summary of Background Data—Back injuries are the most prevalent occupational injury in the United States. Little is known about predictors of lumbar spine surgery following occupational back injury.

Methods—Using Disability Risk Identification Study Cohort (D-RISC) data, we examined the early predictors of lumbar spine surgery within 3 years among Washington State workers with new worker's compensation temporary total disability claims for back injuries. Baseline measures included worker-reported measures obtained approximately 3 weeks after claim submission. We

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The manuscript submitted does not contain information about medical devices or drugs.

used medical bill data to determine whether participants underwent surgery, covered by the claim, within 3 years. Baseline predictors ($P < 0.10$) of surgery in bivariate analyses were included in a multivariate logistic regression model predicting lumbar spine surgery. The model's area under the receiver operating characteristic curve (AUC) was used to determine the model's ability to identify correctly workers who underwent surgery.

Results—In the D-RISC sample of 1,885 workers, 174 (9.2%) had a lumbar spine surgery within 3 years. Baseline variables associated with surgery ($P < 0.05$) in the multivariate model included higher Roland Disability Questionnaire scores, greater injury severity, and surgeon as first provider seen for the injury. Reduced odds of surgery were observed for those under age 35, women, Hispanics, and those whose first provider was a chiropractor. 42.7% of workers who first saw a surgeon had surgery, in contrast to only 1.5% of those who saw a chiropractor. The multivariate model's AUC was 0.93 (95% CI 0.92–0.95), indicating excellent ability to discriminate between workers who would versus would not have surgery.

Conclusion—Baseline variables in multiple domains predicted lumbar spine surgery. There was a very strong association between surgery and first provider seen for the injury, even after adjustment for other important variables.

Keywords

Lumbar spine surgery; back injury; worker's compensation; predictors; prospective study

Introduction

Back pain is the most costly and prevalent occupational health condition among the U.S. working population.[1, 2] Costs relating to occupational back pain increased over 65% from 1996 through 2002, after adjustment for medical and general inflation.[3] Spine surgeries, including those after occupational back injury, represent a significant proportion of these costs and have faced increasing scrutiny regarding effectiveness and efficacy.[4,5] Spine surgeries are associated with little evidence for improved population outcomes,[4] yet rates have increased dramatically since the 1990s.[6–9] Reducing unnecessary spine surgeries is important for improving patient safety and outcomes and reducing surgery complications and health care costs.[10,11] Although previous studies have investigated predictors of outcomes following lumbar spine surgery,[12–16] little research has focused on identifying early (after injury) factors associated with receipt of surgery.[17,18] Knowledge of early predictors of lumbar spine surgery following occupational back injury may help identify workers likely to undergo surgery, which in turn has potential to improve patient outcomes by targeting evidence-based care to such workers. Furthermore, such information is essential for comparative effectiveness studies so that factors associated with receipt of surgery can be assessed and included in adjustment or matching techniques to increase comparability of treatment groups.

We used data from the Washington State Worker's Compensation Disability Risk Identification Study Cohort (D-RISC), a sample of workers with early wage replacement for temporary total disability due to a back injury, to examine the incidence of lumbar fusion and decompression spine surgeries by 3 years after claim submission, identify early

predictors of surgery, develop a multivariate predictive model of surgery, and evaluate the model's ability to predict surgery. We used previous occupational injury, back injury, chronic back pain-related disability, and lumbar spine surgery literature to identify potential early predictors available in the D-RISC baseline data, which include measures in seven domains (sociodemographic, employment-related, pain and function, clinical status, health care, health behavior, and psychological).[19–22] We hypothesized that the following baseline variables would be associated with subsequent lumbar spine surgery: older age,[8,9] higher pain ratings,[16,19,23,24] prescription of opioid medication within 6 weeks from the first medical visit for the injury,[17,25] worker perception that the job is "hectic",[19] no employer offer of job accommodation after the injury,[19] worse psychological factors,[15,16,21,22] worse injury severity,[4–5,17,19] and rural residence.[8,26] We also hypothesized that Hispanic,[9,16,27,28] non-white,[8,9,16,28] and female[8,9,28] workers would have reduced odds of surgery. Finally, we explored whether other variables predicted subsequent surgery.

Materials and Methods

Setting and Participants

The D-RISC study has been described previously.[19–22,25,29] In brief, workers with back injuries were identified prospectively through weekly claims review from the Washington State Department of Labor and Industries (DLI) State Fund, which covers approximately two-thirds of the state's non-federal workforce. Workers who received some wage-replacement compensation for temporary total disability (four days off work) due to the injury were potentially eligible for the study.

In the D-RISC study, 4,354 potential participants were identified from the DLI claims database between June 2002 and April 2004. As previously reported,[19] 1178 (27.1%) could not be contacted successfully soon after the injury, 909 (20.9%) declined enrollment into the study, and 120 (2.8%) were ineligible. The remaining 2147 (49.3%) enrolled in D-RISC and completed a telephone interview, which was conducted a median of 18 days after claim receipt. Study participants were excluded from the D-RISC analysis sample if they were not eligible for compensation in the claim's first year (n=240), were hospitalized for the initial injury (n=16), were missing data on age (n=3), or did not have a back injury according to medical record review (n=3). Thus, 1885 (43.3%) were included in the D-RISC analysis sample. As previously reported,[19] this sample, as compared to workers who received wage-replacement compensation for a back injury but were not in D-RISC, was slightly older [mean age (SD) = 39.4 (11.2) vs. 38.2 (11.1) years, P = 0.001]; contained more women (32% vs. 26%, P <0.001); and had more workers receiving wage-replacement compensation 1 year after claim submission (13.8% vs. 11.3%, P =0.02).

Baseline variables

The D-RISC baseline data came from three sources: administrative claims and medical bill data, medical record review, and worker self-report in telephone interviews.[19–22,25,29] A measure of injury severity was developed for D-RISC and trained occupational health nurses reviewed medical records of visits for the injury and rated injury severity.[22] See Table 1 and

Appendix 1 for additional information about the baseline variables. 52 of 111 available D-RISC variables were examined bivariately.

Outcome measures

To determine whether a worker had lumbar spine surgery covered by DLI within 3 years, we used the DLI computerized medical bill database, which includes dates of service and Current Procedural Terminology (CPT) codes for all medical bills paid by DLI in the claim. We identified all lumbar spine surgery bills using the CPT codes shown in Appendix 2. Our CPT codes vary slightly from a previous code list[30] for lumbar spine surgery; there were no differences in counts or types of surgeries when we used that list. The date of surgery was defined as the first date of service for an included CPT code. We identified operations within 3 years (1095 days) from the date DLI received the claim for the back injury. This period was the longest amount of time surgical data were available for all 1885 D-RISC participants. We categorized the surgeries into fusion, decompression, or both operations for descriptive purposes, but combined them for analytical purposes.

Statistical Analyses

Initially, we conducted bivariate logistic regression analyses to examine associations between baseline variables of interest and lumbar spine surgery, adjusted for worker age and gender. We then constructed a multivariate model for predicting surgery that included baseline variables bivariately associated ($P < 0.10$) with lumbar spine surgery. This criterion of $P < 0.10$ was used because a standard 0.05 P-value level in a bivariate analysis may exclude variables that may be significant in a multivariate model.[31] Analyses were conducted using Stata versions IC10 and MP12.[32] To evaluate the ability of the multivariate model to distinguish between workers who did versus did not undergo surgery by 3 years, we determined the area under the receiver operating characteristic curve (AUC) and used 10-fold cross validation to estimate the AUC in different sub-samples of the D-RISC data.[33] An AUC from 0.70 to 0.80 is considered acceptable and 0.80 to 0.90 is considered excellent.[19,31]

Results

Sample characteristics

Study participants (N=1885) were mostly white non-Hispanic (71%; Hispanic 15% and Other 14%) and male (68%). By 3 years after claim receipt, 174 (9.2%) of the workers underwent one or more lumbar spine operations covered by DLI under the same claim as the index back injury. Among the 174 workers with an operation, 137 (78.7%) had decompression only as the first operation in the claim, 6 (3.4%) had fusion only, and 31 (17.8%) had both procedures on the same day.

Bivariate Analyses

Table 1 shows the baseline variables that had bivariate associations with surgery with $P < 0.10$. Variables that were not significant in bivariate analyses are listed in Appendix 1. All seven domains contained variables associated with lumbar spine surgery. All variables from the pain and function, health care, and psychological domains were associated with lumbar

spine surgery in bivariate analyses. In the sociodemographic domain, suburban residence was associated with higher odds of surgery; younger age, female gender, Hispanic ethnicity, and non-white race were associated with reduced odds. Perception of job as fast-paced, working at current job for less than 6 months, not having returned to original work duties, and not receiving a job accommodation offer from the employer were associated with greater odds of surgery. In the clinical status domain, injury severity, pain radiating below the knee, missing at least 1 month of work due to a previous occupational injury (any type), and receipt of an opioid prescription for the injury were associated with surgery. Using tobacco daily (health behavior domain) was also associated with surgery.

Multivariate Model

The multivariate model (Table 2) included variables that were associated with surgery in bivariate analyses. Due to concerns about collinearity, we examined correlations among the variables in the pain and function and psychological domains; as a result, we did not include variables for pain interference with daily activities,[49] pain interference with work,[49] SF-36 v2 Physical Function,[35] and SF-36 v2 Role Physical[35] in the multivariate model. We did include number of pain sites, pain intensity, Roland-Morris Disability Questionnaire (RMDQ),[34] and all of the variables in the psychological domain. Finally, we did not include self-report of radiating pain below the knee due to its similarity to radiculopathy in the injury severity measure.[19]

Due to missing data on some variables, the multivariate model included 1,857 (98.5%) workers. These workers, as compared to the 28 who were in the D-RISC sample but not in the multivariate model, were less likely to have some college education (52% vs. 61%, P=0.01) No other differences, including undergoing surgery, were identified.

Six variables from four domains contributed independently ($P < 0.05$) to the prediction of lumbar spine surgery in the multivariate model. Workers with high baseline RMDQ scores had six times the odds of surgery compared with those with low scores. Those with greater injury severity and those whose first provider seen for the injury was a surgeon also had significantly higher odds of surgery, after adjusting for all other variables. The surgery provider category included orthopedic surgeons (n=104 workers seen), neurosurgeons (34), and general surgeons (33). Factors associated with significantly reduced odds of surgery included age younger than 35 years, female gender, Hispanic ethnicity, and chiropractor as first provider seen for the injury. No measures in the employment-related, health behavior, or psychological domains were significant.

The AUC value was 0.93 (95% CI 0.92–0.95), indicating a very high ability for the model to distinguish between participants who did and did not undergo lumbar spine surgery.[31] The cross-validation AUC was also 0.93 (95% CI 0.91–0.95). In additional analyses, inclusion of only the RMDQ score, injury severity, and first provider seen for the injury resulted in an AUC value of 0.89 (95% CI 0.87–0.91) and a cross-validation AUC of 0.89 (95% CI 0.86–0.91).

Discussion

In this sample, 9.2% of workers receiving temporary total disability compensation soon after an occupational back injury went on to have lumbar spine surgery in the next three years. This rate is similar to rates of lumbar spine surgery following occupational back injury reported in other studies (9.8%[17] and 10.8%[27]). Measures in four domains predicted surgery: sociodemographic, pain and function, clinical status, and health care.

In an adjusted multivariate model, workers with baseline RMDQ scores of 17 or higher on the 0 – 24 scale had 6 times the odds (adjusted OR=6.12, 95% CI=1.84–20.42) of surgery, as compared with those with scores of 0–8. The RMDQ has also been shown to be predictive of chronic work disability (in a previous study involving the D-RISC sample),[19] longer duration of sick leave,[36] chronic pain,[24] and other measures of function.[37] In a previous D-RISC study of predictors of chronic work disability after back injury, baseline measures in the psychological domain were highly significant in bivariate analyses, but remained significant in a multivariate model only when the RMDQ was excluded from the model.[19] Previous studies noted that participants with lumbar spinal stenosis and discogenic back pain who did versus did not have surgery did not differ prior to surgery on measures of mental health and pain catastrophizing.[18,38] In the current study, several psychological variables were significant in bivariate analyses, but none were significant in the multivariate model, with or without inclusion of RMDQ scores. There is evidence that psychological measures predict patient pain and function outcomes after spine surgery[39,40] and research is needed to identify which combination of disease status, psychosocial, and other measures might best guide treatment decision-making for patients with back pain.

The D-RISC injury severity rating also predicted surgery in the multivariate model. This is consistent with previous findings that radiculopathy influences back pain outcomes, including surgeries.[16,17,24,37] Surgeries may be appropriate treatment for radiculopathy.[41] Odds of surgery were highest for workers with reflex, sensory, or motor abnormalities (19 of 58, or 32.8%, received surgery). Odds were also high for workers with symptomatic radiculopathy without such abnormalities (85 of 344, or 24.7%, received surgery). In future studies investigating lumbar spine surgery, it may be informative, if the number of cases is sufficient, to separate these categories.

In Washington State worker's compensation, injured workers may choose their medical provider. Even after controlling for injury severity and other measures, workers with an initial visit for the injury to a surgeon had almost nine times the odds of receiving lumbar spine surgery compared to those seeing primary care providers, whereas workers whose first visit was to a chiropractor had significantly lower odds of surgery (adjusted OR 0.22, 95% CI=0.10–0.50). Approximately 43% of workers who saw a surgeon had surgery within 3 years, in contrast to only 1.5% of those who saw a chiropractor. It is possible that these findings indicate that "who you see is what you get."[42] Previous studies have noted similar findings using provider surveys of hypothetical patients.[42,43] Persons with occupational back injuries who first saw a chiropractor had lower odds of chronic work disability and early receipt of magnetic resonance imaging (MRIs) in previous reports of data from the D-RISC sample,[19,29] and higher rates of satisfaction with back care.[44] However, patients who

see chiropractors may differ from patients who choose other provider types.[19,45] It may be of interest to worker's compensation programs to evaluate a gatekeeper approach to help ensure the need for lumbar spine surgery.

As hypothesized, Hispanic participants had lower odds of surgery. Prior research has also observed lower rates of spine surgery among Hispanics.[8,9,27,28,46] In an earlier study, Spanish-speaking workers had significantly fewer lumbar spine surgeries within two years of work injury compared to non-Hispanic whites (7.4% vs. 11.0%).[27] These lower odds may reflect cultural barriers and less willingness to undergo surgeries;[9,47] lack of familiarity or understanding of surgery;[9,48] fewer physician referrals to surgery;[28] and discouragement, lack of information, or bias from employers.[4]

Receipt of a prescription for an opioid medication within 6 weeks of claim receipt was not significant in the multivariate model. A previous study linked early opioid use to receiving lumbar spine surgery for a work-related injury, although the study inclusion criteria and methods differed from those of D-RISC.[17] When we matched our inclusion criteria and methods to that study, an opioid prescription was still not significant. We speculate that the difference may be that in the previous study, a measure of worker-related function was not included, whereas in our study the RMDQ was a highly significant predictor of surgery and opioid prescription was no longer significant after adjusting for RMDQ socres.[17]

The multivariate model had excellent ability to distinguish between workers who did or did not have surgery. A model that included only the RMDQ, injury severity, and first provider seen for the injury also had a very high ability to identify workers who did or did not undergo surgery. These three variables may be of use in future research to predict lumbar spine surgery after occupational back injury; they are relatively simple to obtain, use, and interpret.

Our study has some limitations. We had no ability to capture information on surgery covered outside DLI, although it is reasonable to assume that surgeries for the index back injury would be covered by DLI. Although the D-RISC sample consisted of workers with back injuries, some of the CPT codes are not restricted to lumbar-specific spine surgeries. The extent to which our findings may generalize to other settings is unknown. Nonetheless, the study has notable strengths, including complete data for the entire sample on surgery covered by worker's compensation and a large prospective sample of workers who provided detailed information shortly after injury on several factors, as well as data from other sources.

Variables from several domains predicted lumbar spine surgery after occupational back injury. Surgeries were predicted by factors beyond aspects of the injury, such as age, gender, ethnicity, and first provider seen for the injury. Knowledge of surgery predictors may inform interventions or studies on care management of workers with occupational back injuries, including comparative effectiveness studies of surgery for back pain.

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References

1. Courtney TK, Webster JS. Disabling occupational morbidity in the United States. J Occup Environ Med. 1999; 41:60–9. [PubMed: 9924722]
2. Guo HR, Tanaka S, Halperin WE, et al. Back pain prevalence in US industry and estimates of lost workdays. Am J Public Health. 1999; 89:1029–35. [PubMed: 10394311]
3. Shuford H, Restrepo T, Beaven N, Leigh JP. Trends in components of medical spending within workers compensation: Results from 37 states combined. J Occup Environ Med. 2009; 51:232–8. [PubMed: 19209045]
4. Deyo RA, Mirza SK, Turner JA, Martin BI. Overtreating chronic back pain: Time to back off? J Am Board Fam Med. 2009; 22:62–8. [PubMed: 19124635]
5. Chou R, Baisden J, Carragee EJ, Resnick DK, Shaffer WO, Loeser JD. Surgery for low back pain: A review of the evidence for an American Pain Society Clinical Practice Guideline. Spine. 2009; 34 (10):1094–9. [PubMed: 19363455]
6. Cherkin DC, Deyo RA, Loeser JD, Bush T, Waddell G. An international comparison of back surgery rates. Spine. 1994; 19:1201–6. [PubMed: 8073310]
7. Deyo RA, Mirza SK. Trends and variations in the use of spine surgery. Clin Orthop Relat Res. 2006; 443:139–46. [PubMed: 16462438]
8. Wang MC, Kreuter W, Wolfla CE, Maiman DJ, Deyo RA. Trends and variations in cervical spine surgery in the United States: Medicare beneficiaries, 1992 – 2005. Spine. 2009; 34 (9):955–61. [PubMed: 19352223]
9. Alosh H, Riley LH 3rd, Skolasky RL. Insurance status, geography, race, and ethnicity as predictors of anterior cervical spine surgery rates and in-hospital mortality: An examination of United States trends from 1992 to 2005. Spine. 2009; 34(18):1956–62. [PubMed: 19652634]
10. Deyo RA, Mirza SK. The case for restraint in spinal surgery: Does quality management have a role to play? Eur Spine J. 2009; 18 (Suppl 3):S331–7.
11. Weinstein JN, Lurie JD, Olson PR, Bronner KK, Fisher ES. United States' trends and regional variations in lumbar spine surgery. Spine. 2006; 31 (23):2707–14. [PubMed: 17077740]
12. Anderson PA, Schwaegler PE, Cizek D, Leverson G. Work status as a predictor of surgical outcome of discogenic back pain. Spine. 2006; 31 (21):2510–5. [PubMed: 17023863]
13. DeBerard MS, LaCaille RA, Spielmans G, Colledge A, Parlin MA. Outcomes and presurgery correlates of lumbar discectomy in Utah Workers' Compensation patients. Spine J. 2009; 9 (3): 193–203. [PubMed: 18440278]
14. LaCaille RA, DeBerard MS, LaCaille LJ, Masters KS, Colledge AL. Obesity and litigation predict workers' compensation costs associated with interbody cage lumbar fusion. Spine J. 2007; 7 (3): 266–72. [PubMed: 17482108]
15. DeBerard MS, Masters KS, Colledge AL, Holmes EB. Presurgical biopsychosocial variables predict medical and compensation costs of lumbar fusion in Utah workers' compensation patients. Spine J. 2003; 3 (6):420–9. [PubMed: 14609685]
16. Weinstein JN, Tosteson TD, Lurie JD, et al. Surgical versus Nonsurgical Therapy for Lumbar Spinal Stenosis. N Engl J Med. 2008; 358 (8):794–810. [PubMed: 18287602]
17. Webster BS, Verma SK, Gatchel RJ. Relationship between early opioid prescribing for acute occupational low back pain and disability duration, medical costs, subsequent surgery and late opioid use. Spine. 2007; 32 (19):2127–32. [PubMed: 17762815]
18. Kurd MF, Lurie JD, Zhao W, et al. Predictors of treatment choice in lumbar spinal stenosis. A SPORT study. Spine. 2012 Mar 15. (E-Pub ahead of print).
19. Turner JA, Franklin G, Fulton-Kehoe D, et al. ISSLS Prize Winner: Early Predictors of Chronic Work Disability. Spine. 2008; 33:2809–18. [PubMed: 19050587]

20. Turner JA, Franklin G, Fulton-Kehoe D, et al. Prediction of chronic disability in work-related musculoskeletal disorders: A prospective, population-based study. BMC Musculoskeletal Disord. 2004; 5:14.
21. Turner JA, Franklin G, Fulton-Kehoe D, et al. Work recovery expectations and fear-avoidance predict work disability: A longitudinal, population-based study of workers' compensation back injury claimants. Spine. 2006; 31:682–9. [PubMed: 16540874]
22. Stover BD, Turner JA, Franklin G, et al. Factors associated with early opioid prescription among workers with low back injuries. J Pain. 2006; 7:718–25. [PubMed: 17018332]
23. Gureje O, Simon GE, Von Korff M. A cross-national study of the course of persistent pain in primary care. Pain. 2001; 92:195–200. [PubMed: 11323140]
24. Fransen M, Woodward M, Norton R, et al. Risk factors associated with the transition from acute to chronic occupational back pain. Spine. 2002; 27:92–8. [PubMed: 11805644]
25. Franklin GM, Stover BD, Turner JA, Fulton-Kehoe D, Wickizer TM. Early opioid prescription and subsequent disability among workers with back injuries. Spine. 2008; 33 (2):199–204. [PubMed: 18197107]
26. Francis ML, Scaife SL, Zahnd WE. Rural-urban differences in surgical procedures for Medicare beneficiaries. Arch Surg. 2011; 146 (5):579–83. [PubMed: 21242423]
27. Bonauto DK, Smith CK, Adams DA, Fan ZJ, Silverstein BA, Foley MP. Language preference and non-traumatic low back disorders in Washington State workers' compensation. Am J Indust Med. 2010; 53:204–15.
28. Taylor BA, Casas-Ganem J, Vaccaro AR, Hilibrand AS, Hanscom BS, Albert TJ. Differences in the work-up and treatment of conditions associated with low back pain by patient gender and ethnic background. Spine. 2005; 30:359–64. [PubMed: 15682020]
29. Graves JM, Fulton-Kehoe D, Martin DP, Jarvik JG, Franklin GM. Factors associated with early MRI utilization for acute occupational low back pain: A population-based study from Washington State workers compensation. Spine. 2011 Oct 24. e-pub ahead of print.
30. Gray DT, Deyo RA, Kreuter W, et al. Population-based trends in volumes and rates of ambulatory lumbar spine surgery. Spine. 2006; 31 (17):1957–63. [PubMed: 16924213]
31. Hosmer, DW.; Lemeshow, S. Applied Logistic Regression. 2. New York, NY: John Wiley; 2000.
32. StataCorp. College Station, TX: StataCorp LP; 2007. Stata Statistical Software, Version 10.
33. Steyerberg EW, Harrell FE Jr, Borsboom GJJM, et al. Internal validation of predictive models: Efficiency of some procedures for logistic regression analysis. J Clin Epidemiol. 2001; 54:774–81. [PubMed: 11470385]
34. Roland M, Morris R. A study of the natural history of back pain. Part 1: Development of a reliable and sensitive measure of disability in low back pain. Spine. 1983; 8:141–4. [PubMed: 6222486]
35. Ware, JE.; Kosinski, M.; Dewey, JE. How to Score Version Two of the SF-36 Health Survey. Lincoln, RI: Quality Metric; 2000.
36. Steenstra IA, Verbeek JH, Heymans MW, et al. Prognostic factors for duration of sick leave in patients sick listed with acute low back pain: A systematic review of the literature. Occup Environ Med. 2005; 62:851–60. [PubMed: 16299094]
37. Chapman JR, Norvell DC, Hermsmeyer JT, et al. Evaluating common outcomes for measuring treatment success for chronic low back pain. Spine. 2011; 36 (21 Suppl):S54–68. [PubMed: 21952190]
38. Mirza, SK.; Deyo, RA.; Heagerty, PJ.; Turner, JA.; Martin, BI.; Comstock, BA. One-year outcomes of surgical versus non-surgical treatments for discogenic back pain: A community-based comparative effectiveness study. Manuscript under review
39. Daubs MD, Norvell DC, McGuire R, et al. Fusion versus nonoperative care for chronic low back pain: Do psychological factors affect outcomes? Spine. 2011; 36 (21 Suppl):S96–109. [PubMed: 21952192]
40. Celestin J, Edwards RR, Jamison RN. Pretreatment psychosocial variables as predictors of outcomes following lumbar surgery and spinal cord stimulation: A systematic review and literature synthesis. Pain Med. 2009; 10 (4):639–53. [PubMed: 19638142]
41. Voorhies RM, Jiang X, Thoams N. Predicting outcome in the surgical treatment of lumbar radiculopathy using the Pain Drawing Score, McGill Short Form Pain Questionnaire, and risk

factors including psychosocial issues and axial joint pain. Spine J. 2007; 7 (5):516–24. [PubMed: 17905313]

42. Cherkin DC, Deyo RA, Wheeler K, Ciol MA. Physician variation in diagnostic testing: Who you see is what you get. Arthritis Rheum. 1994; 37 (1):15–22. [PubMed: 8129759]
43. Cherkin DC, Deyo RA, Wheeler K, Ciol MA. Physician views about treating low back pain: The results of a national survey. Spine. 1995; 20 (1):1–9. [PubMed: 7709266]
44. Butler RJ, Johnson WG. Satisfaction with low back pain care. Spine J. 2008; 8 (3):510–21. [PubMed: 17602887]
45. Sharma R, Haas M, Stano M. Patient attitudes, insurance, and other determinants of self-referral to medical and chiropractic physicians. Am J Public Health. 2003; 93:2111–7. [PubMed: 14652343]
46. Dembe A. Social inequalities in occupational health and health care for work-related injuries and illnesses. Int J Law Psychiatry. 1999; 22:567–79. [PubMed: 10637758]
47. McCann J, Artinian V, Duhaime L, et al. Evaluation of the causes for racial disparity in surgical treatment of early stage lung cancer. Chest. 2005; 128:3440–6. [PubMed: 16304297]
48. Peterson ED, Shaw LK, DeLong ER, et al. Racial variation in the use of coronary-revascularization procedures. Are the differences real? Do they matter? N Engl J Med. 1997; 336:480–6. [PubMed: 9017942]
49. Von Korff M, Ormel J, Keefe FJ, et al. Grading the severity of chronic pain. Pain. 1992; 50:133–49. [PubMed: 1408309]
50. Sullivan MJL, Bishop SR, Pivik J. The pain catastrophizing scale: Development and validation. Psychol Assess. 1995; 7:524–32.
51. Hazard RG, Haugh LD, Reid S, et al. Early prediction of chronic disability after occupational low back injury. Spine. 1996; 21:945–51. [PubMed: 8726198]
52. Waddell G, Newton M, Henderson I, et al. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain. 1993; 52:157–68. [PubMed: 8455963]
53. Bush K, Kivlahan DR, McDonell MB, et al. The AUDIT Alcohol Consumption Questions (AUDIT-C): An effective brief screening test for problem drinking. Arch Intern Med. 1998; 158:1789–95. [PubMed: 9738608]

Key Points

174 (9.2%) of 1885 workers had one or more lumbar spine surgeries within 3 years of filing a worker's compensation claim for temporary total disability from an occupational back injury. 137 had a decompression procedure, 6 had a fusion without decompression, and 31 had both as the first surgery in the claim.

Significant worker baseline variables in a multivariate model predicting one or more lumbar spine surgeries within 3 years of claim submission included higher Roland-Morris Disability Questionnaire scores, greater injury severity, and first seeing a surgeon for the injury. Participants younger than 35 years, females, Hispanics, and participants whose first visit for the injury was to a chiropractor had lower odds of surgery.

The multivariate model had excellent ability to distinguish between those who did and did not undergo lumbar spine surgery (area under the receiver operating characteristic curve = 0.93).

Spine (Phila Pa 1976). Author manuscript; available in PMC 2014 December 06.

Table 1

Baseline Variables Associated (P < 0.10) with Lumbar Spine Surgery by Three Years after Claim Receipt for Occupational Back Injury*

Domain and variables	No surgery (n=1,711)	Surgery (n=174)	Odds ratio^	95% CI	P-value
Sociodemographics					
Age, years (ref= 35–44 years)	507	72			<0.001
24 years	194	4	0.15	0.05 – 0.41	
25 – 34 years	450	27	0.42	0.26 – 0.66	
45 – 54 years	394	48	0.86	0.59 – 1.27	
55 years	166	23	1.00	0.61 – 1.66	
Gender (ref=male)	1154	128			0.08
Female	557	46	0.73	0.51 – 1.04	
Region of worker residence ° † (ref=urban)	1016	90			0.06
Suburban	257	41	1.77	1.16 – 2.69	
Large town	207	18	1.02	0.60 – 1.75	
Rural	179	18	1.15	0.65 – 2.03	
Race/ethnicity (ref=White non-Hispanic)	1173	145			<0.001
Hispanic	295	12	0.36	0.20 – 0.67	
Other	243	17	0.56	0.33 – 0.95	
Employment-related					
Fast pace (ref=strongly disagree/disagree)	416	35			0.02
Agree	687	63	1.21	0.78 – 1.88	
Strongly agree	602	76	1.78	1.16 – 2.74	
Job duration 6 months	1319	129			0.09
< 6 months	388	45	1.38	0.95 – 1.98	
Employer offered job accommodation (ref=Yes)	800	55			0.001
No/don't know	911	119	1.78	1.27 – 2.49	
Returned to paid work by baseline interview (ref=Yes, same job)	593	14			<0.001
Yes, light duty or different job	444	25	2.44	1.25 – 4.76	
No	673	135	8.28	4.72 – 14.56	
Pain and function					
Number pain sites (ref=0–2 sites)	840	28			<0.001

Domain and variables	No surgery (n=1,711)	Surgery (n=174)	Odds ratio ^	95% CI	P-value
3 – 4 sites	607	110	5.15	3.34 – 7.94	
5 – 8 sites	264	36	4.22	2.50 – 7.11	
Pain intensity, past week (0= no pain, ref= 0–3)[49]	451	7			<0.001
4 – 5	457	38	5.50	2.42 – 12.48	
6 – 7	456	53	8.23	3.68 – 18.37	
8 – 10	344	76	15.26	6.90 – 33.72	
Pain interference with daily activities, past week (0=no interference, ref=0–3)[49]	587	7			<0.001
4 – 5	384	26	5.80	2.48 – 13.52	
6 – 7	333	49	13.04	5.82 – 29.26	
8 – 10	398	98	19.82	9.05 – 43.38	
Pain interference with work, past week (0=no interference, ref=0–3)[49]	625	7			<0.001
4 – 5	314	22	6.44	2.72 – 15.29	
6 – 7	312	39	11.41	5.03 – 25.88	
8 – 10	449	105	21.34	9.80 – 46.48	
Roland-Morris Disability Questionnaire[34]€ (0=no disability) (ref=0–8)	524	4			<0.001
9 – 16	601	37	8.55	3.02 – 24.19	
17 – 24	586	133	31.69	11.59 – 86.63	
SF-36 v2 Physical Function[35]¶ (ref=>50)	445	8			<0.001
41 – 50	325	5	0.85	0.28 – 2.64	
30 – 40	469	29	3.53	1.59 – 7.83	
< 30	471	132	16.16	7.77 – 33.62	
SF-36 v2 Role Physical[35]¶ (ref=>50)	402	3			<0.001
41 – 50	332	7	2.85	0.73 – 11.13	
30 – 40	446	29	8.88	2.68 – 29.43	
< 30	528	135	33.71	10.63 – 106.93	
Pain change since injury (ref=better)	1213	65			<0.001
Same	325	54	3.31	2.24 – 4.87	
Worse	157	54	6.72	4.46 – 10.12	
Clinical status					
Injury severity[22]†† (ref=mild strain/sprain)	991	38			<0.001

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Domain and variables	No surgery (n=1,711)	Surgery (n=174)	Odds ratio ^	95% CI	P-value
Major strain/sprain with substantial immobility but no evidence of radiculopathy	361	20	1.36	0.78 – 2.38	
Evidence of radiculopathy	306	95	7.80	5.21 – 11.68	
Reflex, sensory or motor abnormalities	43	21	11.57	6.19 – 21.65	
Pain radiates below knee (ref=no)	1303	57			<0.001
Yes	408	117	6.43	4.58 – 9.05	
Previous injury (any type) with 1 month off work (ref=no)	1275	100			<0.001
Yes	429	74	1.83	1.32 – 2.54	
Opioid Rx within 6 weeks of injury ° (ref=no)	1131	77			<0.001
Yes	541	94	2.46	1.78 – 3.39	
Health care					
Specialty, first provider seen for injury ° (ref=primary care)	635	45			<0.001
Surgeon	98	73	10.41	6.72 – 16.11	
Occupational medicine	107	16	2.09	1.13 – 3.87	
Chiropractor	534	8	0.21	0.10 – 0.45	
Other	337	32	1.36	0.84 – 2.19	
Time from injury to first medical visit for injury ° (ref=0–6 days)	1336	119			<0.001
7 – 13 days	193	20	1.08	0.65 – 1.79	
14 days	138	32	2.58	1.67 – 3.98	
Health behavior					
Tobacco use (ref=no)	986	84			0.07
Occasionally/frequently	267	24	1.04	0.64 – 1.67	
Daily	505	66	1.49	1.06 – 2.11	
Psychological					
Catastrophizing[50]‡‡ (ref=0–1)	551	15			<0.001
Low (>1 – <2)	282	23	3.02	1.55 – 5.90	
Moderate (2 – <3)	490	70	5.30	2.99 – 9.42	
High (3 – 4)	388	66	6.39	3.57 – 11.43	
Recovery expectations[51] (0–10 scale, 10 = extremely certain will be working in 6 months, ref=10)	993	65			<0.001
High (7 – 9)	331	65	3.04	2.10 – 4.40	
Low (0 – 6)	328	39	1.86	1.22 – 2.84	

Spine (Phila Pa 1976). Author manuscript; available in PMC 2014 December 06.

Domain and variables	No surgery (n=1,711)	Surgery (n=174)	Odds ratio^	95% CI	P-value
Blame for injury[51] (ref=work)	823	92			0.02
Self	339	20	0.52	0.31 – 0.85	
Someone/something else	237	33	1.25	0.81 – 1.92	
Nothing/no one	265	28	0.91	0.58 – 1.42	
Work fear-avoidance[52◇◇] (ref= <3, very low)	361	15			<0.001
Low-moderate (>3 – <5)	567	39	1.71	0.93 – 3.16	
High (5 – 6)	783	120	3.85	2.21 – 6.70	
SF-36 v2 Mental Health[35¶] (ref=>50)	688	30			<0.001
41 – 50	417	56	3.27	2.05 – 5.20	
40	604	88	3.53	2.29 – 5.45	

ref = reference group

*Missing, "don't know," and refusal responses for each variable were combined into one response (unless stated otherwise) for each variable if 15 of responses qualified (results not shown). The following variables had missing responses: region of worker residence (n=59), fast pace (6), job duration (4), returned to paid work by baseline interview (1), pain intensity (3), pain interference with daily activities (9), pain interference with work (12), SF-36 v2 Physical Function (1), SF-36 v2 Role Physical (3), pain change since injury (17), injury severity (10), previous injury (any type) with 1 month off work (7), opioid RX within 6 weeks of injury (42), time from injury to first medical visit for injury (48), tobacco use (3), recovery expectations (64), blame for injury (48), and SF-36 v2 Mental Health (2).

^Age and gender were included in bivariate analyses along with the variable of interest

◇From the DLI database

†By residential zipcode, using the Washington State guidelines classifications at http://www.doh.wa.gov/Data/Guidelines/RuralUrban

€Measures self-reported back disability; higher scores indicate more disability

¶Short-Form-36 version 2 (SF-36v2) Physical Function, Role Physical, and Mental Health scales; higher scores indicate better functioning

††Rated by trained nurses based on medical records early in the claim

‡‡Mean of responses to three questions from the Pain Catastrophizing scale

◇◇Mean of responses to two questions from the Fear-Avoidance Beliefs Questionnaire work scale

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Table 2

Multivariate Model Predicting Lumbar Spine Surgery by Three Years from Baseline Variables

Domain and variables	Bivariate OR^	Bivariate 95% CI	Multivariate OR^^	Multivariate 95% CI	Multivariate P-Value
Sociodemographics					
Age, years (ref= 35–44 years)					0.003
24 years	0.15	0.05 – 0.41	0.23	0.07 – 0.73	
25 – 34 years	0.42	0.26 – 0.66	0.49	0.27 – 0.89	
45 – 54 years	0.86	0.59 – 1.27	0.70	0.41 – 1.18	
55 years	1.00	0.61 – 1.66	1.43	0.73 – 2.82	
Gender (ref=male)					0.0001
Female	0.73	0.51 – 1.04	0.40	0.25 – 0.65	
Region of worker residence (ref=urban)					0.17
Suburban	1.77	1.16 – 2.69	2.00	1.17 – 3.41	
Large town	1.02	0.60 – 1.75	1.31	0.65 – 2.64	
Rural	1.15	0.65 – 2.03	1.08	0.55 – 2.13	
Race/ethnicity (ref=White non-Hispanic)					0.002
Hispanic	0.36	0.20 – 0.67	0.30	0.14 – 0.66	
Other	0.56	0.33 – 0.95	0.51	0.26 – 0.9991	
Employment-related					
Fast pace (ref=strongly disagree/disagree)					0.25
Agree	1.21	0.78 – 1.88	1.45	0.81 – 2.61	
Strongly agree	1.78	1.16 – 2.74	1.63	0.90 – 2.95	
Job duration 6 months					0.71
< 6 months	1.38	0.95 – 1.98	1.10	0.68 – 1.77	
Employer offered job accommodation (ref=Yes)					0.43
No/don't know	1.77	1.26 – 2.48	1.22	0.74 – 2.01	
Returned to paid work by baseline interview (ref=Yes, same job)					0.74
Yes, light duty or different job	2.44	1.25 – 4.76	1.23	0.55 – 2.88	
No	8.28	4.72 – 14.56	1.34	0.64 – 2.79	
Pain and function					
Number pain sites (ref=0–2 sites)					0.60

Spine (Phila Pa 1976). Author manuscript; available in PMC 2014 December 06.

Domain and variables	Bivariate OR^	Bivariate 95% CI	Multivariate OR^^	Multivariate 95% CI	Multivariate P-Value
3 – 4 sites	5.15	3.34 – 7.94	1.34	0.76 – 2.35	
5 – 8 sites	4.22	2.50 – 7.11	1.28	0.65 – 2.52	
Pain intensity, past week (0= no pain, ref= 0–3)[49]					0.18
4 – 5	5.50	2.42 – 12.48	2.39	0.90 – 6.36	
6 – 7	8.23	3.68 – 18.37	1.67	0.62 – 4.49	
8 – 10	15.26	6.90 – 33.72	2.36	0.86 – 6.50	
Roland-Morris Disability Questionnaire[34 €] (0=no disability) (ref=0–8)					0.0003
9 – 16	8.55	3.02 – 24.19	2.52	0.78 – 8.10	
17 – 24	31.69	11.59 – 86.63	6.12	1.84 – 20.42	
Pain change since injury (ref=better)					0.50
Same	3.31	2.24 – 4.87	1.06	0.62 – 1.80	
Worse	6.72	4.46 – 10.12	1.56	0.84 – 2.90	
Clinical status					
Injury severity (ref=mild strain/sprain)					<0.0001
Major strain/sprain with substantial immobility but no evidence of radiculopathy	1.36	0.78 – 2.38	0.84	0.43 – 1.62	
Evidence of radiculopathy	7.80	5.21 – 11.68	4.34	2.62 – 7.17	
Reflex, sensory or motor abnormalities	11.57	6.19 – 21.65	5.73	2.62 – 12.52	
Previous injury (any type) with 1 month off work (ref=no)					0.32
Yes	1.83	1.32 – 2.54	1.19	0.86 – 1.66	
Opioid Rx within 6 weeks of injury (ref=no)					0.38
Yes	2.46	1.78 – 3.39	0.87	0.65 – 1.18	
Health care					
Specialty, first provider seen for injury (ref=primary care)					<0.0001
Surgeon	10.41	6.72 – 16.11	8.69	5.03 – 15.01	
Occupational medicine	2.09	1.13 – 3.87	1.39	0.67 – 2.87	
Chiropractor	0.21	0.10 – 0.45	0.22	0.10 – 0.50	
Other	1.36	0.84 – 2.19	1.38	0.78 – 2.45	
Time from injury to first medical visit for injury (ref=0–6 days)					0.32
7 – 13 days	1.08	0.65 – 1.79	0.74	0.39 – 1.40	
14 days	2.58	1.67 – 3.98	1.49	0.82 – 2.72	
Health behavior					

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Domain and variables	Bivariate OR^	Bivariate 95% CI	Multivariate OR^^	Multivariate 95% CI	Multivariate P-Value
Tobacco use (ref=no)					0.38
Occasionally/frequently	1.04	0.64 – 1.67	0.66	0.36 – 1.21	
Daily	1.49	1.06 – 2.11	0.95	0.60 – 1.50	
Psychological					
Catastrophizing[50 ‡‡] (ref=0–1)					0.18
Low (>1 – <2)	3.02	1.55 – 5.90	1.75	0.73 – 4.18	
Moderate (2 – <3)	5.30	2.99 – 9.42	2.28	1.05 – 4.93	
High (3 – 4)	6.39	3.57 – 11.43	2.15	0.94 – 4.90	
Recovery expectations[50] (0–10 scale, 10 = extremely certain will be working in 6 months, ref=10)					0.38
High (7 – 9)	3.04	2.10 – 4.40	0.87	0.51 – 1.48	
Low (0 – 6)	1.86	1.22 – 2.84	0.97	0.56 – 1.67	
Blame for injury[51] (ref=work)					0.09
Self	0.52	0.31 – 0.85	0.72	0.38 – 1.35	
Someone/something else	1.25	0.81 – 1.92	1.17	0.67 – 2.06	
Nothing/no one	0.91	0.58 – 1.42	0.96	0.52 – 1.76	
Work fear-avoidance[52 ∞] (ref= <3, very low)					0.27
Low-moderate (>3 – <5)	1.71	0.93 – 3.16	1.00	0.47 – 2.16	
High (5 – 6)	3.85	2.21 – 6.70	1.47	0.71 – 3.04	
SF-36 v2 Mental Health[35] (ref=>50)					0.26
41 – 50	3.27	2.05 – 5.20	1.31	0.72 – 2.40	
40	3.53	2.29 – 5.45	0.87	0.48 – 1.58	

Each baseline variable included in this table was associated (P < 0.10) in bivariate analyses with back surgery by three years after occupational back injury

ref = reference group

^ adjusted for age and gender, except for age and gender

^^ adjusted for all other variables in the multivariate model

Spine (Phila Pa 1976). Author manuscript; available in PMC 2014 December 06.

Appendix 1

Non-Significant Bivariate Associations (P 0.10) of Baseline Variables with Lumbar Spine Surgery by One Year after Initial Claim Receipt for Occupational Back Injury*

Domain and variables	No surgery (n=1,711)	Surgery (n=174)	Odds ratio^	95% CI	P-value
Sociodemographics					
Education (ref=high school)	581	65			0.25
Less than high school	234	17	0.64	0.36 – 1.12	
Vocational or some college	745	80	0.90	0.64 – 1.28	
College	150	12	0.64	0.34 – 1.23	
Marital status (ref=married/living with partner)	1107	112			0.32
Other	601	62	1.15	0.82 – 1.60	
Employment-related					
Worker's industry ° ǂ (ref=trade/transportation)	423	40			0.42
Natural resources	86	8	1.01	0.45 – 2.25	
Construction	292	44	1.62	1.02 – 2.57	
Manufacturing	137	13	0.92	0.48 – 1.79	
Management	281	27	1.00	0.59 – 1.67	
Education and health	262	22	0.93	0.51 – 1.68	
Hospitality	230	20	1.04	0.59 – 1.85	
Co-worker relations (0 – 10 scale, ref=10, get along extremely well)	889	101			0.24
8 – 9	610	60	0.93	0.66 – 1.31	
0 – 7	197	13	0.61	0.33 – 1.12	
Heavy lifting (ref=not at all/rarely/occasionally)	810	77			0.27
Frequently	526	63	1.29	0.90 – 1.84	
Constantly	372	34	1.03	0.67 – 1.59	
Whole body vibration (ref=not at all/rarely)	1163	108			0.35
Occasionally/frequently	361	42	1.19	0.80 – 1.78	
Constantly	184	24	1.34	0.82 – 2.19	
Physical demands (ref=sedentary/light)	356	28			0.22
Medium	538	57	1.37	0.85 – 2.21	
Heavy	407	40	1.31	0.78 – 2.21	

Domain and variables	No surgery (n=1,711)	Surgery (n=174)	Odds ratio ^	95% CI	P-value
Very heavy	400	49	1.69	1.02 – 2.80	
Excessive amount of work (ref=strongly disagree/disagree)	746	73			0.29
Strongly agree/agree	945	101	1.19	0.86 – 1.64	
Enough time to do job (ref=Strongly agree/agree)	1226	131			0.43
Strongly disagree/disagree	485	43	0.86	0.60 – 1.24	
Very hectic (ref=Strongly disagree/disagree)	463	56			0.28
Agree	775	68	0.74	0.51 – 1.08	
Strongly agree	463	49	0.90	0.59 – 1.36	
Supervisor listens to my work problems (ref=agree)	987	94			0.40
Strongly disagree/disagree	337	36	1.15	0.76 – 1.73	
Strongly agree	361	42	1.30	0.88 – 1.93	
Satisfaction with job (ref=Somewhat or very satisfied)	1456	152			0.70
Not at all or not too satisfied	251	21	0.91	0.56 – 1.47	
Job type at time of injury (ref=full-time)	1548	165			0.12
Part-time	162	9	0.58	0.29 – 1.19	
Seasonal job at injury (ref=no)	1595	165			0.45
Yes	115	9	0.77	0.38 – 1.56	
Temporary job at injury (ref=no)	1599	162			0.83
Yes	110	11	0.93	0.49 – 1.78	
Pain and function (all significant)					
Clinical status					
Previous similar back injury (ref=no)	971	95			0.59
Yes	739	78	0.91	0.66 – 1.26	
Number of self-reported worker's compensation claims before current injury (ref=0)	720	48			0.13
1	498	61	1.53	1.02 – 2.28	
2 – 3	327	44	1.57	1.01 – 2.44	
4	148	19	1.39	0.78 – 2.46	
Work days missed because of back, previous year (ref=0)	1140	122			0.54
1 – 10	399	33	0.80	0.53 – 1.20	
> 10	138	14	0.90	0.50 – 1.63	
Work days missed because of other health problems, previous year (ref=0)	730	72			0.39

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Domain and variables	No surgery (n=1,711)	Surgery (n=174)	Odds ratio ^	95% CI	P-value
1 – 10	835	86	1.12	0.80 – 1.56	
> 10	106	15	1.53	0.84 – 2.80	
Number other major medical problems (ref=0)	1454	139			0.36
1	255	35	1.21	0.80 – 1.83	
Current health aside from injury (ref=excellent)	331	36			0.84
Very good	608	63	0.97	0.63 – 1.49	
Good	553	56	0.92	0.59 – 1.44	
Fair/poor	216	19	0.89	0.49 – 1.59	
General health, year prior to injury (ref=excellent)	380	51			0.15
Very good	625	59	0.69	0.46 – 1.03	
Good	524	45	0.63	0.41 – 0.96	
Fair/poor	179	19	0.83	0.47 – 1.46	
Health care					
Health insurance (ref=yes)	1154	121			0.96
No	555	52	0.99	0.70 – 1.40	
Health behavior					
Alcohol Use Disorder Identification Test-	1220	124			0.56
Consumption (AUDIT-C)[53] ^^ (ref=negative, AUDIT-C score of 0 – 3 for males, 0 – 2 for females)					
Positive (4 – 12 for males, 3 – 12 for females)	481	50	1.11	0.78 – 1.58	
Baseline Body Mass Index (BMI) (ref=<25)	521	38			0.13
25 – 29 (overweight)	660	72	1.32	0.87 – 2.00	
30 (obese)	489	62	1.54	1.01 – 2.37	
Psychological (all significant)					

ref = reference group

* Missing, "don't know," and refusal responses for each variable were combined into one response for each variable as needed. They were not included in analyses. The following variables had missing responses: education (n=1), marital status (3), co-worker relations (15), heavy lifting (3), whole body vibration (3), physical demands (10), excessive amount of work (20), very hectic (11), supervisor listens to my work problems (28), satisfaction with job (5), job type at time of injury (1), seasonal job at injury (1), temporary job at injury (3), previous similar back injury (2), number of self-reported worker's compensation claims before current injury (20), work days missed because of back in the previous year (39), work days missed because of other health problems in the previous year (41), other major medical problems (2), current health aside from injury (3), general health in year before injury (3), health insurance (3), AUDIT-C (10), and baseline BMI (43)

^ Adjusted for age and gender

° Obtained from DLI database

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‡ Derived from standard industrial codes (SIC)

^^ The AUDIT-C score is a screening test for problematic alcohol usage

Appendix 2

CPT codes identifying lumbar spine surgeries by fusion and decompression operations

CPT Codes	
Fusion	
20930	Allograft, morselized, or placement of osteopromotive material, for spine surgery only
20931	Allograft, structural, for spine surgery only
20937	Autograft for spine surgery only (includes harvesting the graft); morselized (through separate skin or fascial incision)
20938	Autograft for spine surgery only (includes harvesting the graft); structural, bicortical or tricortical (through separate skin or fascial incision)
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)
22612	Arthrodesis, posterior or posterolateral technique, single level; lumbar (with or without lateral transverse technique)
22614	Arthrodesis, posterior or posterolateral technique, single level; each additional vertebral segment
22625	Lumbar spine fusion
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
22830	Exploration of spinal fusion
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)
22842	Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 3 to 6 vertebral segments
22843	Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 7 to 12 vertebral segments
22844	Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 13 or more vertebral segments
22845	Anterior instrumentation; 2 to 3 vertebral segments
22846	Anterior instrumentation; 4 to 7 vertebral segments
22847	Anterior instrumentation; 8 or more vertebral segments
22849	Reinsertion, spinal fixation device
22850	Removal, posterior nonsegmental instrumentation (not specifically lumbar)
22851	Application of intervertebral biomechanical device(s) (eg, synthetic cage(s), methylmethacrylate) to vertebral defect or interspace
22852	Removal, posterior segmental instrumentation (not specifically lumbar)
22855	Removal, anterior instrumentation (not specifically lumbar)
Decompression	
22102	Partial excision of posterior vertebral component (eg, spinous process, lamina or facet) for intrinsic bony lesion, single vertebral segment; lumbar
63005	Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (eg, spinal stenosis), 1 or 2 vertebral segments; lumbar, except for spondylolisthesis
63012	Laminectomy with removal of abnormal facets and/or pars inter-articularis with decompression of cauda equina and nerve roots for spondylolisthesis, lumbar (Gill type procedure)
63017	Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (eg, spinal stenosis), more than 2 vertebral segments; lumbar

63030	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of herniated intervertebral disc, including open and endoscopically-assisted approaches; 1 interspace, lumbar
63035	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of herniated intervertebral disc, including open and endoscopically-assisted approaches; each additional interspace, cervical or lumbar
63042	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of herniated intervertebral disc, reexploration, single interspace; lumbar
63044	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of herniated intervertebral disc, reexploration, single interspace; each additional lumbar interspace
63047	Laminectomy, facetectomy and foraminotomy (unilateral or bilateral with decompression of spinal cord, cauda equina and/or nerve root[s], [eg, spinal or lateral recess stenosis]), single vertebral segment; lumbar
63048	Laminectomy, facetectomy and foraminotomy (unilateral or bilateral with decompression of spinal cord, cauda equina and/or nerve root[s], [eg, spinal or lateral recess stenosis]), single vertebral segment; each additional segment, cervical, thoracic, or lumbar
63056	Transpedicular approach with decompression of spinal cord, equina and/or nerve root(s) (eg, herniated intervertebral disc), single segment; lumbar (including transfacet, or lateral extraforaminal approach) (eg, far lateral herniated intervertebral disc)
63057	Transpedicular approach with decompression of spinal cord, equina and/or nerve root(s) (eg, herniated intervertebral disc), single segment; each additional segment, thoracic or lumbar
63087	Vertebral corpectomy (vertebral body resection), partial or complete, combined thoracolumbar approach with decompression of spinal cord, cauda equina or nerve root(s), lower thoracic or lumbar; single segment
63088	Vertebral corpectomy (vertebral body resection), partial or complete, combined thoracolumbar approach with decompression of spinal cord, cauda equina or nerve root(s), lower thoracic or lumbar; each additional segment
63090	Vertebral corpectomy (vertebral body resection), partial or complete, transperitoneal or retroperitoneal approach with decompression of spinal cord, cauda equina or nerve root(s), lower thoracic, lumbar, or sacral; single segment
63091	Vertebral corpectomy (vertebral body resection), partial or complete, transperitoneal or retroperitoneal approach with decompression of spinal cord, cauda equina or nerve root(s), lower thoracic, lumbar, or sacral; each additional segment
63102	Vertebral corpectomy (vertebral body resection), partial or complete, lateral extracavitary approach with decompression of spinal cord and/or nerve root(s) (eg, for tumor or retropulsed bone fragments); lumbar, single segment
63103	Vertebral corpectomy (vertebral body resection), partial or complete, lateral extracavitary approach with decompression of spinal cord and/or nerve root(s) (eg, for tumor or retropulsed bone fragments); thoracic or lumbar, each additional segment
63267	Laminectomy for excision or evacuation of intraspinal lesion other than neoplasm, extradural; lumbar
63709	Repair of dural/cerebrospinal fluid leak or pseudomeningocele, with laminectomy