Geographic Variation in Spine Care Among Injured Workers.

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Abstract

This project addressed two National Occupational Research Agenda priority areas: occupational health services research and low back pain. Back pain among workers is an enormous medical, social, and economic burden in the United States. Back disorders account for 27% of all disabling occupational injuries in the United States and the average direct cost of a low back injury claim is more than twice that of other occupational injury claims combined. Surgical interventions are responsible for nearly one-third of the health care costs for workers with back injury. There is a lack of consensus among physicians, however, about the appropriate use of surgical interventions that result in large regional variations in care. The primary goal of the study was to examine community differences in the rate and types of spinal surgery performed on injured workers using small area analysis. Small area analysis is a commonly employed method in health services research but there have been limited applications of this technique in occupational health research. Oregon, as well as a number of neighboring Western states, has been identified as having elevated rates of spine surgery compared to the rest of the nation and significant local variation exists among communities based on prior analyses of Medicare claims data. The study was designed to evaluate whether a similar pattern of local variation existed for workers' compensation claims and to evaluate factors contributing to observed variations including physician specialty, physician supply, source of payment, and the effect of managed care. This project piloted the use of an existing state database of workers' compensation medical payments.

Highlights/Significant Findings

Of the 1662 surgical events analyzed, nearly all (99%) were performed by medical doctors (M.D.). A small number (1%) were performed by osteopathic doctors, nearly all attributable to one provider, reflecting the small osteopathic physician workforce, and the emphasis on primary care among osteopathic physicians. Slightly over two-thirds (65%) of the procedures were performed by neurosurgeons, and one-third (33.3%) by orthopedic surgeons. A small number (1.6%) of events lacked information on the provider specialty.

The majority of procedures (76.7%) were performed on male claimants, and on the lumbar spine (78.0%). Most procedures (72.8%) did not result in a arthrodesis (fusion), but of the 452 identified fusion procedures, most (82%) did include the use of hardware for internal fixation.

These data suggest that on a statewide level, approximately 4.3% of claimants seeking treatment for a spinal condition underwent an invasive spinal procedure as a hospital in-patient (HI) during calendar years 1999-2000. The proportion of claimants who underwent an invasive procedure varied geographically, however, from a high of 5.1 % in Bend, OR to a low of 2.4% in Salem, OR, a nearly two-fold variation.

We estimated a civilian workforce of approximately 1.6 million in Oregon during the study period, suggesting a statewide rate of approximately 0.92 workers receiving a spinal surgical procedure/1000 workers. The rate varied substantially by hospital referral region, however, from a high of 1.62/1000 in Bend, OR to a low of 0.57/1000 in Salem, OR, an almost threefold variation.

These data confirm that there is substantial geographical variation in the use of invasive spinal procedures in Oregon. Further analyses are required to determine what provider, patient, and community characteristics might be contributing to this variation.

Translation of Findings

This study provided a valuable opportunity to conduct health services research in workers' compensation using an existing data base that is rich in information. It applied the technique of small area analysis to workers' compensation, an area where this proven technique for health services research has had limited application. This technique has been applied to Medicare data, and previously published analyses of Medicare claims allows for comparison of health care delivery under workers' compensation to other payment systems. Because of its focus on the surgical treatment of spinal disorders this study addressed an important, costly, and controversial area in the care of injured workers.

Outcomes/Relevance/Impact

The study confirmed substantial variation in community patterns of spine surgery in workers' compensation, and the need for further study of treatment patterns and

outcomes for a number of work-related injuries and illnesses. These methods can be applied to other geographic units or other diagnoses to analyze the individual, community and provider variables that influence the treatment of work-related injuries and illnesses, and may provide an important opportunity to improve the quality and cost of care for injured workers.

Scientific Report

Background

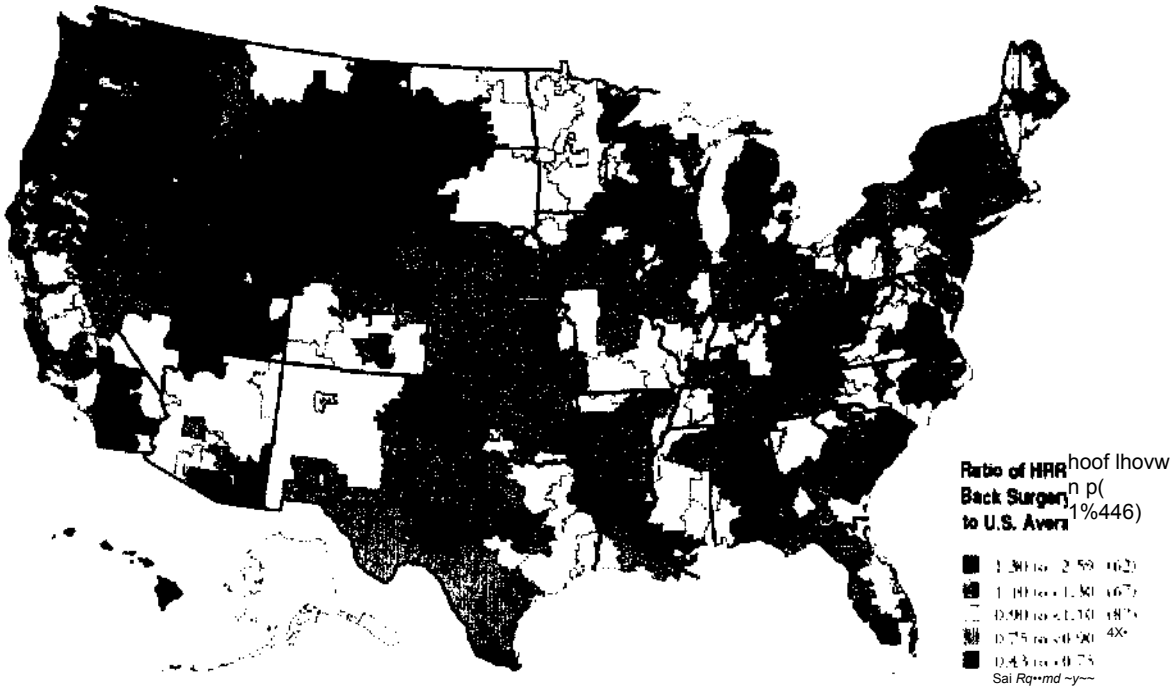
Health services research is an emerging and largely underdeveloped facet of occupational safety and health research. The application of established health services research methods and the development of novel approaches are needed to understand workers' access to care, quality of care, provider supply and demand, utilization patterns and costs. One important part of occupational health services research addresses the need for and development of preventive and clinical practice guidelines for work-related injury and illness. [1, 27]

Back disorders account for 27% of all disabling occupational injuries in the United States and the average direct cost of a low back injury claim is more than twice that of other occupational injury claims combined. [l] The total cost to society of low back injuries was estimated to be between $50 and $100 billion dollars in 1990 with nearly $11 billion dollars allocated to the workers' compensation system. Therefore, back pain among workers represents an enormous medical, social, and economic burden in the United States.

Surgical interventions account for as much as one-third of the health care costs for back pain, and some workers will choose a surgical solution for their low back pain despite the paucity of medical evidence demonstrating efficacy. [2] Improvements in the quality of care that injured workers receive, and the appropriate allocation of resources, are hampered by a lack of a consensus regarding the indications for surgery, the most appropriate surgical techniques, or even the appropriate outcome measures to determine efficacy. [2-24]

Previous studies among Medicare beneficiaries have shown wide variation in the rate of spinal surgery for low back pain throughout the United States and abroad. (See Figure 1.)

Figure 1: Ratio of Spine Surgery Rates to U.S. Average Rate by Hospital Referral Region (HRR).



In 1995-96, The *Dartmouth Atlas* of *Healthcare* demonstrated an eight-fold variation in the rate of surgery for disk herniation (0.24 per 1000 Medicare beneficiaries in York, PA to 1.96 per 1000 in Boise, ID) and a twelve-fold variation in surgery for lumbar spinal stenosis (0.29 per 1000 in Johnson City, TN to 3.34 per 1000 in Bend, OR) among U.S. communities. It is unlikely that this eight to twelve-fold variation can be solely explained by differences in the prevalence or severity of back pain but instead appears to represent significant local variation in physician practice. For example, some Oregon communities have rates of spinal surgery well above the national mean and Bend, Oregon leads the nation with its rate of lumbar spinal stenosis surgery procedures among Medicare enrollees. These differences exist even among communities that share similar economic and demographic characteristics. The demonstrated variation among Medicare enrollees invites additional studies to determine if similar variation exists for other healthcare payment sources including workers' compensation.

Among U.S. Medicare enrollees, per capita rates of cervical spine surgery varied ten fold, while rates of lumbar discectomy varied by a factor of 15. [25] Use of a fusion procedure as part of lumbar spine surgery also varied ten fold. In comparison, rates of total hip replacement and knee replacement surgery, also performed primarily for pain relief and functional restoration, varied by a factor of five or less.

Over the past 10-15 years, spine surgery rates in the United States have been steadily increasing among Medicare enrollees. Rates increased 57% in the ten years between 1988 and 1997 from 2.1 to 3.4 per 1000 Medicare enrollees. [25] The proportion of spinal fusion surgeries among all back surgeries has similarly increased from 23% in 1993 to 29% in 1997 even though the indications for this surgery remain controversial. The

proportion of patients undergoing internal fixation devices (implanted orthopedic hardware) rose from 50% to 60% in the same period [25] despite the lack of evidence showing improved clinical outcomes with fixation devices. [2]

The reasons for these variations are likely multi-factorial and difficult to conclusively establish. Some amount of the variation may arise from local differences in disease prevalence but there appears to be a substantial contribution from individual and community factors. For example, although 98% of all hip fractures are treated surgically, an approximately two-fold geographic variation in the rate of hip fracture surgery exists among Medicare enrollees. This probably represents some variation in the underlying incidence of hip fractures themselves.

It is unlikely, however, that the regional incidence of spinal pathology is different enough to explain the extreme variation in surgical rates in the United States. Even within these national regions, significant local variations exist among neighboring communities which often share similar population characteristics. (See Figure 2.) The majority of this variation, instead, appears to arise from differences in individual, community and provider variables that influence the treatment of work-related injuries and illnesses.

The proportion of surgeries by physician specialty also varies significantly by the anatomic location and type of procedure performed. Neurosurgeons performed 85% of cervical spine procedures but only 59% of lumbar decompressions. Orthopedic surgeons were more likely to include fusion in lumbar procedures and to use internal fixation instruments in both cervical and lumbar procedures. [25] While significant differences in surgical approach to mock case histories have been demonstrated to exist based on training background (Hart, et al.), and identification of hospital specific "surgical footprints" have been demonstrated using Medicare data, no assessment of physician specialty contribution to total variation in spine surgical rates have been performed. This proposal allows assessment of this variable within a large cohort of injured workers.

The existence of such variation among specialists is significant. While documenting the presence of variation does not answer the question of what the appropriate rate of spine surgery should be, the lack of greater uniformity would seem to imply that optimal indications for spine surgical intervention are not known, or at least not uniformly understood by spine practitioners, Further efforts at determining the source and extent of such variations may provide guidance in helping define and ultimately provide appropriate spine surgical care.

Since 1990, the State of Oregon has required all insurers and self-insurers with at least one hundred accepted claims per calendar year to submit data on payments to physicians and hospitals. This database provides a unique and rich source of data on the utilization of medical services in workers' compensation. Although we initially propose to examine community patterns in spine surgery, it is anticipated that the database can be similarly used to study treatment patterns and outcomes for a number of work-related injuries and illnesses. The methods described in this application can be applied to other geographic units or other diagnoses and thereby serves as a model for analyzing the individual

community and provider variables that influence the treatment of work-related injuries and illnesses.

We attempted to use workers' compensation claims data to determine to what extent the frequency and type of spinal surgery among workers' compensation beneficiaries varied geographically and to evaluate to what extent individual, community and provider variables such as physician supply or physician specialty contributes to that variation.

Specific Aims

We proposed in this project to use workers' compensation claims data to estimate the rates of spinal surgery, both overall and by specific type of operation, among workers in this population. By using these estimated rates we intended to:

1. Determine to what extent the rate and type of spinal surgery among workers' compensation beneficiaries varies geographically and to what extent physician supply or physician specialty contributes to that variation.

2. Determine if the patterns of geographic variation in spinal surgery among workers' compensation beneficiaries are similar to those previously observed among Medicare beneficiaries, and to observe the characteristics of communities that have consistently high or low patterns of utilization.

3. Determine if the rates and types of spinal surgery vary within and outside of managed care organizations for workers' compensation and evaluate the impact of managed care interventions such as surgical pre-authorization, concurrent review, or practice guidelines.

Methods

This was a descriptive study of spinal surgery utilization in an existing workers' compensation database. The database was used to obtain the number and type of spinal surgeries performed within small geographic units of the State of Oregon. These units are derived from contiguous U.S. Postal Service Zip Codes whose residents primarily seek treatment from a particular hospital (hospital service area) or tertiary medical center (hospital referral region). [25] Estimates of the population of workers in these geographic areas were derived from U.S. Census Bureau 2000 Census Data.

Linkage of data sets was used to compute rates of spinal surgery among workers with spinal disorders and to examine sources of variation as described in the specific aims.

Description of Data Sources

This project was performed using data obtained from the Information Management Division of the Oregon Department of Consumer and Business Services (DCBS). This data was available through an interagency agreement between DCBS and The Center for Research on Occupational and Environmental Toxicology (CRUET). The database that

was used will be referred to as `Bulletin 220 Data" after the official document that advised workers' compensation insurers of the requirement to submit this data and prescribed the record layout.

Data collection started in 1990 in response to a major reform of the Oregon Workers' Compensation system. The reporting requirements were revised in 1998 to include: pharmacy data (National Drug Compendium (NDC) codes); physician specialty; and secondary diagnosis codes. The Department's intended purposes for the data included legislative and policy analysis, medical outcomes studies, identifying community standards and trends, cost analysis, Managed Care Organization (MCO) and provider performance comparisons, and provider profiling.

The administrative rules of DCBS (OAR 436-009-0100(1) and 436-010-0270) specify that this data must be provided to DCBS in a standard electronic format on a quarterly basis by all insurers and self-insurers that have at least 100 accepted disabling claims in a calendar year. Insurers below this threshold are encouraged to participate voluntarily. See Appendix, Table Al for a list of participating insurers and self-insurers.

Data must be transmitted in electronic text files and in conformance with the standard record layout as provided in Table 2.

Table 1: Record Layout for Bulletin 220 Electronic Data-Transmission

DESCRIPTION	ALPHA NUMERIC	POSITION	LENGTH	REQUIREMENT
Insurer's WCD number3	9.00	1.00	4.00	Required
Insurer's claim number	X	5.00	20.00	Required
Claimant's SSN	9.00	25.00	9.00	Required
Date of injury (YYYYMMDD)4_.	9.00	34.00	8.00	Required
Medical-only or disabling (MorD)	X	42.00	1.00	Optional
Medicalprovider-type5	X	43.00	2.00	Required
Medical provider specialty6	X	45.00	3.00	Required
Medical provider federal ID No.	X	48.00	10.00	Required
Medical provider SSN or PIN8	X	58.00	9.00	Optional
MCO number8	X	67.00	6.00	Required
ICD-9-CM diagnosis code8	X	73.00	6.00	Requiredl
Secondary ICD-9-CM diagnosis code8	X	79.00	6.00	Optional

Service, drug, or procedure code8	X		85.00	1100	Required
Modifier codel l	X	_	96.00	2.00	Required
Date of service (YYYYMMDD)4	9.00		98.00	8.00	Required
Date of payment (YYYYMMDD)4	9.00		106.00	8.00	Required
Charge amount signl2	X		114.00	1.00 _	Required
Charge amount13	9.00		115.00	6.00	Required
Payment amount signl2	_ X		121.00	1.00	; Required
Payment amountl3	9.00		122.00	600	Required
Number of units or services8	9.00		128.00	2.00	Required
9.00 = Numerical dataX			= Character or alphanumericdata.		

Insurers are required to report all medical payments for services covered by the Department's workers' compensation fee schedules. These include Anesthesiology, Surgery, Radiology, Pathology and Laboratory, Medicine, Physical Medicine, Evaluation and Management, Oregon Specific Codes, hospital services, pharmacy, and durable medical equipment. Insurers are also encouraged to report payments on non-fee schedule services such as dental and ambulance. All subsequent adjustments to payments are also reported.

Data fields included in the required reporting format are: medical provider types (See Appendix, Table A2) and provider specialty (See Appendix, Table A3); medical provider SSN or PIN; managed care organization (MCO) number; International Classification of Diseases (ICD-9-CM) diagnosis codes; service, drug, or procedure codes (e.g., Current Procedural Terminology (CPT), Oregon Medical Fee And Relative Value Schedule (OMFARVS), National Drug Compendium code (NDC), ICD-9-CM procedure code), and the number of units or services. Hospital inpatient services are coded using ICD-9-CM procedure codes (no CPT). Hospital outpatient services include a diagnostic (ICD-9) code and a service (CPT, HCPCS, or other) code.

DCBS conducts electronic audits for blank or invalid data. Files which have more than five percent missing or invalid data in any field based on initial computerized are returned to the insurer for correction. DCBS also conducts field audits of actual payments reported for individual claims.

Before transferring data, DCBS removed the claim number and the claimant's social security number from the data set to protect individual privacy. DCBS replaced it with a coded identifier.

Ascertainment of Spinal Surgery and Surgery Type

The initial transfer of data was for two calendar years, 1999 and 2000, to permit initial pilot testing of the methods on a smaller dataset and an opportunity to gain experience

with the data elements and data management procedures. The claims were identified using the following codes:

In-Patient Hospital Charges	• ICD-9-CM Procedure Codes • Oregon Medical Fee And Relative Value Schedule (OMFARVS)
Out-Patient Hospital Charges	• ICD-9-CM Diagnosis Codes • Current Procedural Terminology (CPT) Codes • Oregon Medical Fee And Relative Value Schedule (OMFARVS)
Physician Charges	• ICD-9-CM Diagnosis Codes • Current Procedural Terminology (CPT) Codes • Oregon Medical Fee And Relative Value Schedule (OMFARVS)

ICD-9-CM Diagnosis Codes are derived from the World Health Organization's International Classification of Diseases. This hierarchical coding system was developed for epidemiological and statistical purposes but was adapted for clinical use (Clinical Modification) by the American Hospital Association (AHA) and the American Association of Medical Record Librarians (AAMRL) in 1955. It was subsequently modified and continues to be updated by the U.S. Public Health Service National Center for Health Statistics. It is widely used in clinical settings for reimbursement purposes.

Current Procedural Terminology (CPT) Codes are assigned and updated by the American Medical Association (AMA) and denote specific clinical services provided by physicians and allied health practitioners. These codes are primarily designed and used for billing and reimbursement purposes.

The Oregon Medical Fee And Relative Value Schedule (OMFARVS) include codes for services that are unique to the Oregon workers' compensation system or are not described in the AMA's Current Procedural Terminology (CPT) system. These include physician charges for administrative reports, legal depositions, physical therapy and vocational services, for example.

The ICD-9-CM Procedure Codes were used to identify hospitalizations for spinal surgery procedures. All in-patient hospital claims which include payment for one of the ICD-9 procedure codes listed in Table A4 constituted a "case" for this study. These claims were linked to the corresponding physician charge to confirm the diagnosis, the type of

procedure performed, and to assign the surgery to a particular provider. Linking these two payments was used in an attempt to validate data fields and to provide an opportunity to fill missing fields if they existed in one of the records.

Surgical procedures were categorized and tabulated by spine location (cervical, thoracic or lumbosacral), whether they included a fusion procedure and if so, whether hardware was used (instrumented vs. non-instrumented).

Ascertainment of Provider Characteristics and Geographic Region

Cases were assigned to a Hospital Service Area (HSA) based on the identity and the zip code of the hospital where the services were provided. As described in the *Dartmouth Atlas* of *Health Care, zip* codes have been previously assigned to Hospital Service Areas (HSA) which are in turn assigned to Hospital Referral Regions. [25] Hospital Referral Regions are determined similar to the methods for assigning HSAs but represent larger geographic areas that use a particular tertiary care medical center. There are five Hospital Referral Regions (HRR) in Oregon as defined in the *Dartmouth Atlas* include Bend (#341), Eugene (#342), Medford (#343), Portland (#344), and Salem (#345). (See Figure 4.) All cases were assigned to one of these five HRRs and the HRRs were the primary unit of analysis for calculation and comparison of rates and proportions. The total number of spine procedures and the subcategories of procedures were determined for each HRR.

Physician surgical charges were linked to the hospital charge using the file identification number (this unique number was assigned to the claim after all personal identifiers are removed) and then aggregated to HRR in a similar manner. Provider characteristics (type, specialty) were linked to each case.

Figure 2: Oregon Hospital Referral Regions

Estimation of Worker Population

The number of workers covered by workers' compensation in each HRR per year is not directly available through any existing data source. Estimates of the number of covered workers in the state during each annual period are available from DCBS and correlate strongly with data on non-agricultural wage-earners in the state available from the Oregon Department of Employment. Data on the number of wage earners is available at the zip code level but is aggregated by the zip code of the employer rather than the residence address of the individual employees. These data, therefore, was not sufficient for establishing rate denominators but can be used to validate estimates derived from other sources.

In order to calculate rates, the number of covered employees for each HRR was estimated from the number of employed individuals residing in each zip code from 2000 US Census data. Calculation of the proportion of workers in each HRR who received surgical treatment from the population of all workers receiving treatment for spinal disorders, (e.g., the number of workers who received treatment for a spinal disorder (ICD-9

diagnosis codes 721-724 and 739.1-739.4 during the year) was determined by zip code of residence. Aggregating these zip codes by HRR provided an estimate of the geographical variation in spinal disorders within the State. Analyzing the frequency of surgery among the entire population of workers who receive treatment for a spinal condition in the workers' compensation system removes some of the potential concerns about confounding from geographic variation in the prevalence of spinal disorders. Because the primary aim of the study is to analyze geographic variation relative to other regions (HRR's) within the state, these denominator estimates were felt sufficient to calculate relative rates because the estimates of the working population in each HRR were uniformly derived.

Data Analysis

Specific Aim 1: Determine to what extent the rate and type of spinal surgery among workers' compensation beneficiaries varies geographically and by physician specialty as a result of physician practice patterns.

Geographic variation in spinal surgery rates

The total number of spinal surgeries and the subcategories of procedures were divided by the number of employed individuals in each HRR to obtain estimated annual per capita rates of surgery. The proportion of workers with spinal diagnoses who undergo surgical treatment was also determined by dividing the number of surgical cases by the number of all workers receiving treatment for spinal disorders within each HRR. The number of workers with spinal disorders was determined by identifying all workers who received treatment for a selected ICD-9-CM diagnosis. These ICD-9-CM diagnoses include codes 721 (Spondylosis and allied disorders), 722 (Intervertebral disc disorders), 723 (Other disorders of the cervical region), 724 (Other and unspecified disorders of the back) and 739.1-739.4 (Nonallopathic spinal lesions, not elsewhere classified).

The crude rates were adjusted using the indirect method for age and gender of the working population using the United States Standard Population (2000). The adjusted rates were then compared to determine if significant geographic variation exists among HRRs.

We also calculated the relative proportion of each of the various categories of spinal surgery (e.g., cervical vs. lumbosacral, fusion - present or absent and type, instrumented vs. non-instrumented, etc.) and evaluate trends in the types of surgeries performed over the study period by HRR and overall.

Specific Aim 2: Determine if the rates and types of spinal surgery among workers' compensation beneficiaries show a pattern of geographic variation similar to that previously observed among Medicare beneficiaries.

We compared the results of the analysis above to the analysis of cotemporaneous Medicare Claims data in the *Dartmouth Atlas* of *Health Care*. Direct comparison of rates was not possible because of differences in the methods for calculating and adjusting rates but an ordered ranking of HRRs similar to the *Dartmouth Atlas* established that the same HRRs show the same relative patterns of high and low utilization for two different payment sources and populations (workers' compensation and Medicare). The value of

this analysis is the ability to test whether the differences in source of payment (i.e., different reimbursement rates, administrative requirements of workers' compensation vs. Medicare) result in different patterns of utilization. These rankings will be analyzed probabilistically for significance using a permutation test.

Specific Aim 3: Determine if the rates and types of spinal surgery vary within and outside of workers' compensation managed care organizations as a result of physician practice patterns and the presence or absence of physician practice guidelines.

One outcome of the 1990 reform of the Oregon workers' compensation system was the introduction of managed care. Employers and insurers can contract with independent managed care organizations (MCO) to reduce costs and control utilization of medical care for injured workers. Because the Bulletin 220 data includes a code identifying the managed care organization, if present, we will be able to evaluate differences between workers within and outside of managed care organizations.

Previous studies of managed care in workers' compensation have suggested that medical outcomes are similar within and outside of managed care. Employers satisfaction with managed care is greater than employee satisfaction but this difference is small and is primarily focused on issues of access to care (i.e., a pre-selected panel of physicians). [49, 52, 53]

Unfortunately, this analysis could not be completed during the project period with the available data sources.

Results

The initial dataset contained approximately 960,500 records. Each record contained the ICD-9 diagnosis code, service, provider type, service date, date of injury, date of birth, gender, injured worker's home zip, and a dummy file number so that all services in single claim could be grouped together. This dataset was not limited by the claim's status, rather it included all the records reported as required by the Bulletin 220 (e.g. it is not only accepted, closed, or inactive claims).

A second dataset was also obtained that was identical to the first, except it only included closed claims. It contained all records with the 3-digit ICD-9 diagnosis subcodes 720-724 and 846-847 with services performed on or between 1/1/1999 and 12/31/2000 and had all the same fields as the first dataset. Since it only included closed claims there were fewer records, and the second dataset contained approximately 432,000 records.

Because the first dataset contained all the records with the 3-digit ICD-9 diagnosis subcodes 720-724 and 846-847 with services performed on or between 1/I/1999 and 12/31/2000, only the records that matched to the claims system contained the date of birth, gender, and zip data. All the records in the second dataset, however, were matched to the claims systems in order to determine if the claim was closed. This dataset included the date of birth, gender, and zip data for all claims and was assumed to be valid in nearly all of the records except for the errors introduced during data entry.

Data problems that were identified during the study included diff¡culty in determining the geographic zip code of where the medical service was provided. When the provider zip was unavailable and could not be deternlined from the Bulletin 220 data, the claimants home address zip code was used.

After data cleaning and reducing the dataset to the variables of interest, one major challenge was to develop an algorithm to group multiple bills for services into single events, and code them to a specific surgical procedure and surgeon. The dataset had a large number of missing or miscoded variables and many surgical events were associated with non-surgical providers. A decision rule algorithm was developed that imputes the surgeon using nonsurgery events on the same or nearby dates. A surgery with an unidentified surgeon was attributed to a surgeon of appropriate training who performed a non-surgical service within 90 days prior or 14 days following a surgery.

Removing all nonsurgery services by nonsurgeons excluded 565,411 events. Removing all nonsurgery services with a surgeon, if that surgeon is already represented in another service within "event" range (one day before or after) excluded 19,109 services. Additionallly, removing duplicates of same service and provider within event range excluded 4,197 events and excluding duplicate hospital surgical costs excluded an additional 1,114 events. The remaining 2,859 records were subsequently combined into 1,662 distinct surgery events.The dataset was transferred into a Microsoft Access database in preparation for the creation of an ArcGIS Geodatabase.

Remaining: 1662 events

PROVIDER TYPE

Medical Doctor (MD)	1645 (99.0%)
Doctor of Osteopathy (DO)	17 (1.0%)

23 events had both MD and OS; for these the priority provider was assessed via GrouplD and Provider ID lookup tables.

PROVIDER SPECIALTY

Neurosurgery (NSU)	1081 (65.0%)
Orthopedic Surgery (ORS)	554 (33.3%)
Not specified (UNK)	27 (1.6%)

27 events had both NSU and ORS; for these the priority provider's specialty was assessed via GroupiD and ProviderlD lookup tables. Most often these were coded UNK due to lack of clarity resulting from having multiple providers per ID. 6 additional events that had neither NSU nor ORS were evaluated the same way and ultimately coded UNK

ZIP CODES

Oregon	1508 (90.7 %)
non-Oregon	154 (9.3%)

GENDER

Male	1274 (76.7 %)
Female	388 (23.3 %)

BODY REGION

Cervical	363	(21.8 %)
Lumbar	1295	(78.0 %)
Thoracic	4	(0.2 %)

70 Events that were not coded to a specific region automatically by lookup CPT were hand-verified against CPTs and ICD-9 codes. CPT-associated regions took priority over ICD-9-soecifeed regions. In case of *conflict, CPTs for surgical events were used*

4 Events had both L and C regions specified by CPT on same-day of *treatment. Evaluated by ICD-9 to assign region as follows: 2 cases were receded to lumbar, 2 cases were receded to cervical.*

PROCEDURE TYPE

Surgical	1210 (72.8%	
Fusion	82	(4.9 %)
Hardware	370	(22.3 %)

FREQU ENCY OF SURGERY

Table 2: Proportion of Oregon workers' compensation claimants with a spinal condition undergoing an invasive spinal procedure as a hospital inpatient. (1999-2000)

Hospital Referral Region	Number of claimants with a spinal condition receiving an in-hospital invasive procedure	Number of claimants with a spinal condition receiving any treatment,	Proportion of claimants with a spinal condition receiving an in-hospital invasive procedure (%)	Ratio of spinal surgery cases to statewide average.
Bend	79	1558	5.1	1.19
Eugene	199	4487	4.4	1.02
Medford	84	1965	4.3	1.0
Portland	423	9781	4.3	1.0
Salem	37	1525	2.4	0.55
Statewide	822	19316	4.3	

Table 3: Estimate of Oregon workers' compensation claimants receiving a surgical procedure per 1000 workers. (1999-2000)

HRR	CITY	Number of claimants with a spinal condition who underwent a surgical procedure	Projected workforce from Census 2000 Data	Estimate of number of surgical claims/ 1000 workers	Ratio of spinal surgery cases to statewide average.
341	Bend	120	80654	1.49	1.62
342	Eugene	421	307622	1.37	1.49
343	Medford	151	144459	1.05	1.14
344	Portland	720	936759	0.77	0.84
345	Salem	68	130900	0.52	0.57
Statewide		1480	1600394	0.92	

Figure 3: Proportion of Back-Related Claims that Resulted in Surgical Treatment by Oregon Hospital Service Area (HRR)

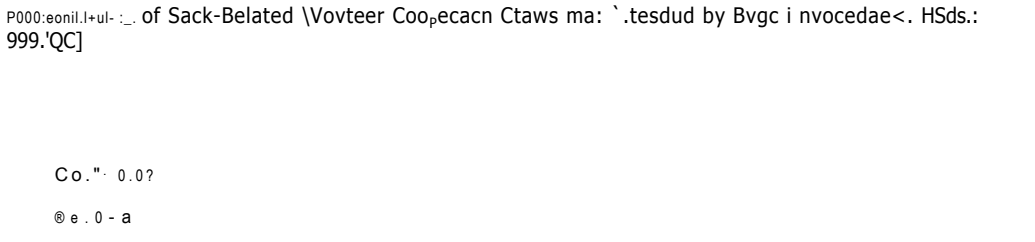


Figure 4: Proportion of Back-Related Claims that Resulted in Surgical Treatment by Oregon Hospital Referral Region (HRR)

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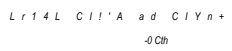

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Figure 5: Rate of Disabling Back-Related Claims that Resulted in Surgical Treatment (per 1000 civilian workers) by Oregon Hospital Service Area (USA)

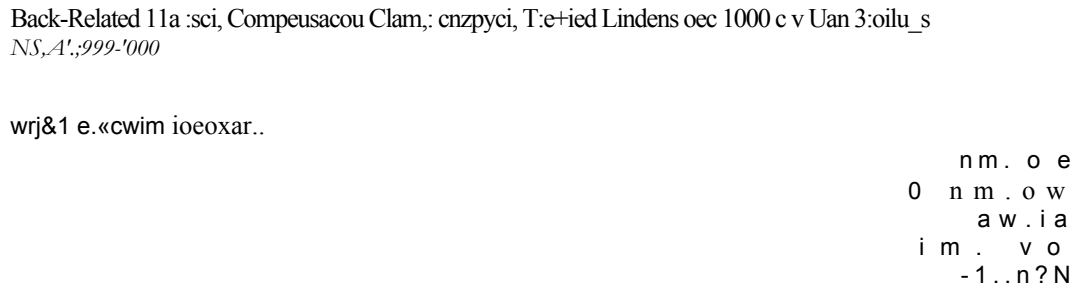

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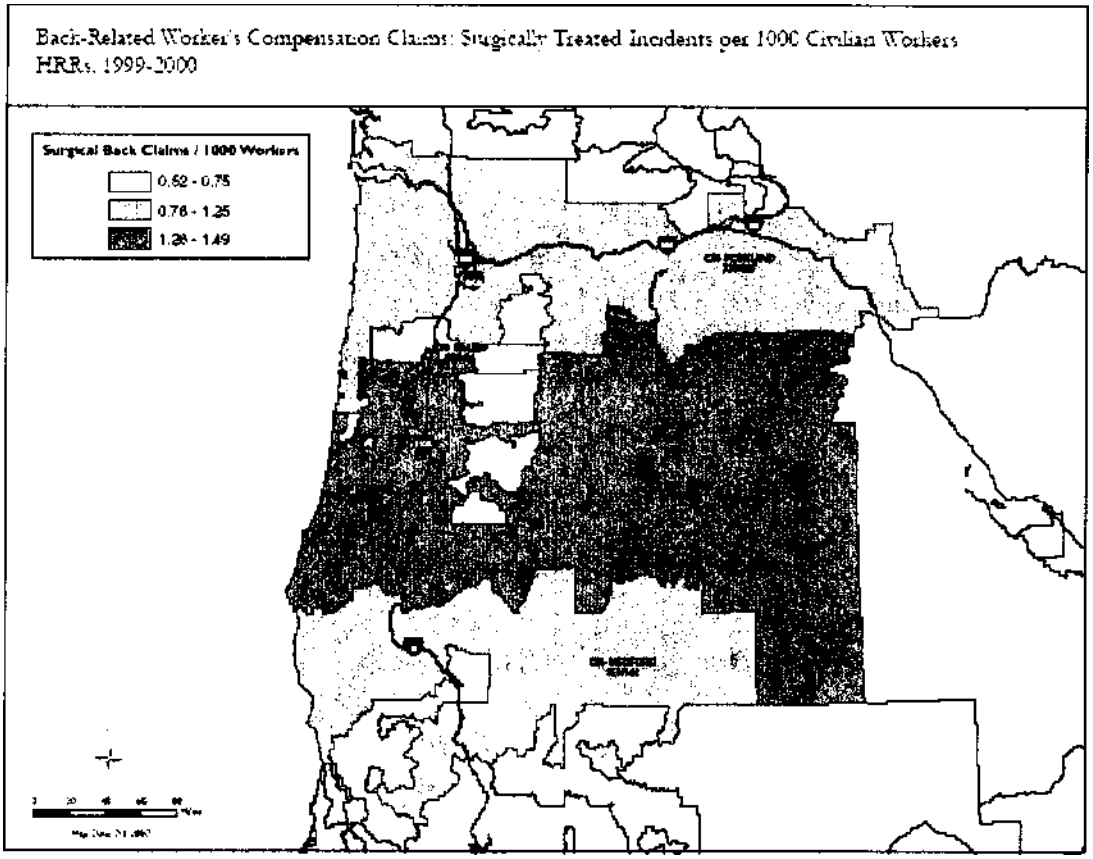
Figure 6: Rate of Disabling Back-Related Claims that Resulted in Surgical Treatment (per 1000 civilian workers) by Oregon Hospital Referral Region (HRR)



Discussion

This project was an outgrowth of a previously funded NIOSH project, "Partnerships in Surveillance and Prevention." That project was a collaboration between CROET, the Environmental and Occupational Epidemiology Section of the Oregon Department of Human Services, Health Services Division (OHD), and several major workers' compensation insurers in Oregon. It examined disparities in work injury data available in the state-mandated WC system and those available in the databases held by private insurers and self-insured companies.

During that project we gained access to another workers' compensation database maintained by the State known simply as "Bulletin 220." This database, described in more detail earlier in this report had potential value for conducting health care utilization, reimbursement, injury and disease epidemiology, and health outcomes studies in workers' compensation. The recognition of the potential value of this database led to the submission of this proposal to conduct an analysis on geographic variations in surgical utilization and to explore other potential areas of health services research using it.

A query of the Bulletin 220 database revealed that 1662 spinal surgical events occurred during calendar years 1999-2000. These records were sorted by zip code and assigned to a Hospital Service Area (has) and to a Hospital Referral Region (HRR) using the methodology described in the *Dartmouth Atlas of Health Care*. [25] The five Hospital Referral Regions (HRR) in Oregon as defined in the *Dartmouth Atlas* include Bend (#341), Eugene (#342), Medford (#343), Portland (#344), and Salem (#345). Valid zip codes were available for all cases but 154 (9.3%) of these claimants resided in a zip code that was outside of one of the Oregon HRRs leaving 1508 surgical cases performed on 1480 individual claimants that were available for analysis. Eight hundred twenty-two claimants were admitted to a hospital for their invasive spinal procedure, the remainder were presumed to have been performed in free standing ambulatory surgery centers or physician offices.

The database was also used to identify all claimants who received any medical treatment for a spinal condition using ICD-9-CM diagnostic codes for traumatic or degenerative spinal disorders (ICD-9 diagnosis codes 721-724 and 739.1-739.4). This query revealed that 21,272 claimants sought treatment for these diagnoses during the 1999-2000 calendar years. Eighty-one (0.4%) of these claimants had an invalid zip code, and 1,875 (8.8%) resided in a zip code that was outside of one of the Oregon HRRs providing 19,316 claimants with a spinal diagnosis.,:

Of the 1662 surgical events, nearly all (99%) were performed by medical doctors (M.D.). A small number (1%) were performed by osteopathic doctors, nearly all attributable to one provider, reflecting the small osteopathic physician workforce, and the emphasis on primary care among osteopathic physicians.

Slightly over two-thirds (65%) of the procedures were performed by neurosurgeons, and one-third (33.3%) by orthopedic surgeons. A small number (1.6%) of events lacked information on the provider specialty.

The majority of procedures (76.7%) were performed on male claimants, and on the lumbar spine (78.0%).

Most procedures (72.8%) did not result in a arthrodesis (fusion), but of the 452 identified fusion procedures, most (82%) did include the use of hardware for internal fixation.

These data suggest that on a statewide level, approximately 4.3% of claimants seeking treatment for a spinal condition underwent an invasive spinal procedure as a hospital in-patient (HI) during calendar years 1999-2000. The proportion of claimants who underwent an invasive procedure varied geographically by HRR, however, from a high of 5.1% in Bend, OR to a low of 2.4% in Salem, OR.

Using Census 2000 data, we estimated a civilian workforce of approximately 1.6 million during the study period. This suggested a statewide rate of approximately 0.92 claimants receiving a spinal surgical procedure/1000 workers. The rate varied geographically by HRR, however, from a high of 1.62/1000 in Bend, OR to a low of 0.57/1000 in Salem, OR, an almost threefold variation.

These data confirm that there is geographical variation in the use of invasive spinal procedures among with workers with spinal conditions. Further analyses are required to determine what provider, patient, and community characteristics might be contributing to this variation. For example, is the lower proportion of surgical treatments in the Salem HRR a consequence of patients traveling outside of their residence HRR (e.g., Portland or Eugene) for treatment?

This study provided a valuable opportunity to conduct health services research in workers' compensation using an existing data base that is rich in information. It applied the technique of small area analysis to workers' compensation, an area where this proven technique for health services research has had limited application. This technique has been applied to Medicare data, and previously published analyses of Medicare claims allows for comparison of health care delivery under workers' compensation to other payment systems. Because of its focus on the surgical treatment of spinal disorders this study addressed an important, costly, and controversial area in the care of injured workers.

Weaknesses of the study included the inability to calculate true rates since the actual number of workers covered by the workers' compensation system in each geographic unit is unknown. This prevented the calculation of true rates but because the emphasis was on variation the calculation of relative rates addressed the stated aims of the project. Because insurers who have fewer than one hundred accepted claims per year were not required to participate, the data reflected payments by most, but not all, insurers within the state. It is possible that a small but unrecognized insurer or self insurer could have had an impact in a particular community that could skew results. This would be most unlikely given the emphasis on larger hospital referral regions for analysis. Additionally, confounding could have arisen from geographic variation in the distribution or the severity of the disorders.

Although the available data sources did not contain a measure of severity, this seems unlikely.

In summary, the findings provided intriguing information on variation in community patterns in spine surgery in workers' compensation, and it is anticipated that as the database and data quality is improved, it can be used to study treatment patterns and outcomes for a number of work-related injuries and illnesses. These methods can be applied to other geographic units or other diagnoses to analyze the individual, community and provider variables that influence the treatment of work-related injuries and illnesses, and may provide an important opportunity to improve the quality and cost of care for injured workers.

Publications

None

Inclusion of Gender and Minority Study Subjects

All study procedures were approved in advance by the Institutional Review Board at Oregon Health and Science University.

This research involves the use of existing data collected by the State of Oregon. The data will be provided to the investigator without personal identifiers. It will not be possible to identify subjects directly or through identifiers linked to the subjects. Although this study is health services research, if it is determined to be exempt under Category 4, it will not be considered clinical research under the NIH definition.

E.1.b. Women, Minorities, and Children

The study data is contained in an existing database maintained by the State of Oregon. The population of workers represented by the data will likely be similar to the demographic characteristics of the Oregon workforce. Data from the 2000 Census indicates that 10.7% of Oregon residents are non-white and 8% are Hispanic or Latino (of any race). (U.S. Census Bureau, Census 2000) Affirmative action data from the State of Oregon Employment Department estimate that 17.2% of the Oregon workforce are minorities (Black, 1.7%; Native American, 1.8%; Asian/Pacific Islander, 3.6%; Hispanic (all races), 10.1%; and Female (all races) 44.7%). A recent study estimated that 75% of Hispanics (16 and older) are in the workforce compared to 68% of whites. (Oregon Employment Department, December 2001)

Data regarding age and gender are collected in the workers' compensation claims files, but no information regarding race or ethnicity is appended to the claim. Data available from the Oregon Department of Consumer and Business Services indicate that for the year 2000 of 24,982 accepted disabling claims 7,980 (32%) were from women and 624 claims were filed by youths ages 18 and under (2.5%).

E.2. Sources of Individual -Identifiable Research Material

Data will come from existing records held by the State of Oregon Department of Consumer and Business Services who is cooperating in this project. The study personnel will adhere to the Department's specifications regarding data security. If personal identifiers are included in the electronic data, they will be removed by study personnel and only a unique study identifier will be used for linkages purposes.

E.3. Recruitment and Consent

This project uses existing records and involves no recruitment or consent procedures.

Inclusion of Children

Not Applicable

Materials available for other investigators

None