



U.S. Department of Veterans Affairs

Public Access Author manuscript

Spine (Phila Pa 1976). Author manuscript; available in PMC 2017 September 13.

Published in final edited form as:

Spine (Phila Pa 1976). 2012 May 01; 37(10): 860–874. doi:10.1097/BRS.0b013e3182376508.

Identifying Neck and Back Pain in Administrative Data: Defining the right cohort

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Structured Abstract

Study design—We reviewed existing methods for identifying patients with neck and back pain in administrative data. We compared these methods using data from the Department of Veterans Affairs.

Objective—To answer the following questions: 1) what diagnosis codes should be used to identify patients with neck and back pain in administrative data; 2) because the majority of complaints are characterized as non-specific or mechanical, what diagnosis codes should be used to identify patients with non-specific or mechanical problems in administrative data; and 3) what procedure and surgical codes should be used to identify patients who have undergone a surgical procedure on the neck or back.

Summary of background data—Musculoskeletal neck and back pain are pervasive problems, associated with chronic pain, disability, and high rates of healthcare utilization. Administrative data have been widely used in formative research which has largely relied on the original work of Volinn, Cherkin, Deyo and Einstadter and the Back Pain Patient Outcomes Assessment Team first published in 1992. Significant variation in reports of incidence, prevalence, and morbidity associated with these problems may be due to non standard or conflicting methods to define study cohorts.

Methods—A literature review produced seven methods for identifying neck and back pain in administrative data. These code lists were used to search VA data for patients with back and neck problems, and to further categorize each case by spinal segment involved, as non-specific/mechanical and as surgical or not.

Results—There is considerable overlap in most algorithms. However, gaps remain.

Conclusions—Gaps are evident in existing methods and a new framework to identify patients with neck and back pain in administrative data is proposed.

Keywords

Back pain; Neck pain; Low back pain; Back Pain/epidemiology; Databases; Factual; Disease/classification; Health Services Research

Neck and back pain are highly prevalent problems and administrative data are commonly used to describe the incidence, prevalence, and geographic variation in practice for these conditions.¹⁻¹¹ This work has largely relied on the methods published in 1992 by Volinn, Cherkin, Deyo and Einstadter and the Back Pain Patient Outcomes Assessment Team (BOAT)^{12, 13, 14} that identified neck and back pain from ICD-9¹⁵ codes and used hospitalization as a proxy for morbidity.^{12-14, 16, 17} This original work has led to a broad range of research on neck and back problems using hospital, workers' compensation and Medicare data.¹⁸⁻²⁵ More recently, the International Society for Pharmacoeconomics and Outcomes Research²⁶ has adopted guidelines for conducting and reviewing research using retrospective administrative databases, but this guideline, while successful in creating an international standard for doing this type research, does not address the idiosyncracies of spine data. With these new guidelines and two decades of changes in medical practice²⁴ as well as a change in focus from analyzing events to evaluating episodes of care,^{27, 28} a revised methodology may be needed. The purpose of this study was to review methods used to identify patients with neck or back pain in administrative data and, if appropriate, establish a revised framework. Our objective for these analyses was to answer three questions: 1) what diagnosis codes should be used to identify patients with neck and back pain in administrative data; 2) because the majority of complaints are characterized as non-specific or mechanical, what diagnosis codes should be used to distinguish these particular patients in administrative data from patients with more complex problems; and 3) what diagnosis and procedure and surgical codes should be used to identify patients who have undergone surgical or invasive procedures on the neck or back.

Methods

We used a snowball sampling approach to identify algorithms used to identify patients with neck or back pain problems in administrative data. We started by searching the Web of Knowledge (Thomson Reuters Institute for Scientific Information) for articles that referenced Cherkin, Deyo's 1992 publication.¹³ Next, we searched PubMed to identify studies that reported using diagnosis or procedure codes to identify these patients in administrative data, using key words and MeSH terms; we focused on studies written in English. (Search logic is available in Appendix A) These searches plus additional recommendations identified 170 manuscripts for review. We excluded twelve papers based on review of the title (for example, conditions other than neck or back pain) and reviewed 158 abstracts and 48 manuscripts in depth. (APPENDIX B lists the manuscripts reviewed in depth.) Studies were excluded, for example, if they did not include a code algorithm or list²⁹⁻³¹, if the study included only a limited number of diagnoses or reported on a limited number of surgical procedures³²⁻³⁹, or if the reports did not involve the use of previously collected administrative data. We additionally excluded studies that were not about neck or back pain, and those studies that used the original Cherkin and Deyo algorithm^{13, 18-23}

without modification. This review yielded six papers including Cherkin and Deyo¹³ that listed diagnosis and procedure-based algorithms for coding neck and back pain (see Table 1).^{12–14, 16, 17, 40,}

Angevine et al.¹⁷ used the most limited list of diagnoses and procedures to identify care for cervical disc disease. Martin et al.⁴⁰ had the broadest list of codes to estimate costs of neck and back care using the Medical Expenditure Panel Survey (MEPS). The six studies generally used the same criteria to define non-specific/mechanical neck or back pain, excluding cases with evidence of neoplasm, trauma, inflammatory spondyloarthropathies, and infection or pregnancy. Investigators additionally limited their analyses to adults (exclusion range <15 to < 20 years of age) and clinical conditions (e.g. spinal stenosis, congenital anomalies and pathologic fracture) depending on their data sources and their research questions.

To this list of six papers, we added the AHRQ Healthcare Cost and Utilization Project (HCUP) Clinical Classification Software⁴² algorithms for “Spondylosis; intervertebral disc disorders; other back problems” (category 205) and “Sprains and strains” (category 232). Category 232 - includes all body parts, but we included only those codes that refer specifically to the spine. Between the six papers and two HCUP categories, we had a total of eight coding algorithms. The inclusion and exclusion codes are listed in Appendix C. Because the Cherkin & Deyo paper¹³ extended work by Volinn and Loeser,^{12, 43} we have not incorporated the Volinn list in this table.

These seven algorithms had varying and sometimes conflicting definitions of neck and back pain. Because of this and because current research and clinical practice guidelines differentiate between pain originating in the neck and pain originating in other areas of the spine,^{44, 45} we standardized our definitions for this project. We adopted the following definitions, consistent with international work⁹: “spine pain” includes conditions that originate *anywhere in the spine*; “neck pain” includes conditions that *originate in the cervical spine*; “back pain” includes conditions *originating from the thoracic, lumbar, and sacral spine, including the coccyx*; and “low back pain” includes conditions that arise from the *lumbar and sacral spine, including the coccyx*.⁹ These conditions could be “associated with pain as well as causing radicular symptoms from compression or irritation of nerve roots”.¹³ Non-specific or mechanical spine pain was defined as “without primary neoplastic, infectious, or inflammatory cause” and excluding codes consistent with “pregnancy or major trauma”.^{13, 16}

The algorithms shared many features and their differences were primarily definitional (See Appendix C). Most inclusion and exclusion criteria followed the Cherkin and Deyo¹³ algorithm, except Taylor,¹⁶ which included thoracic diagnoses in the definition of back and neck problems, and the HCUP back category which included cervical and thoracic diagnoses and the diagnoses pertaining to the coccyx. The most significant differences were between the Cherkin and Deyo¹³ algorithm, HCUP category 205, and Martin et al.⁴⁰ In these studies they differed in their definitions of neck vs. back and whether the report was about any neck and back problems, or limited to non-specific problems [e.g. whether to include or exclude ankylosing spondylitis and other inflammatory spondylopathies (720.0 – 720.9), curvatures

of the spine, (737.0–737.9), acquired spondylolisthesis and other acquired deformity of the back or spine (738.4–738.5), nonallopathic lesions of the spine (739.1–739.4), anomalies of the spine (756.10–756.2), open or closed spinal fractures with and without mention of spinal cord injury (805 – 806), and other, multiple and ill-defined vertebral dislocations (839.0–839.5)]. In addition, there are many codes for which the spinal segment is not defined (721.90; 721.91; 722.2; 722.6; 722.70; 722.90; 738.4; and 847.9; 996.4) and were included in both low back and neck pain algorithms. At the end of Appendix C, these non-specific codes and the exclusions due to conditions which were used by Cherkin and Deyo¹³ to define “non-specific or mechanical low back pain” are included.

To evaluate the differences in these seven algorithms, we used administrative data from the Veterans Health Administration (VA). We identified all patients who received health care services for back or neck problems in fiscal years (FY) 2002 through 2009, analyzing the VA Patient Treatment Files for inpatient utilization and the National Patient Care Database encounter files for outpatient data, using the inclusion diagnosis codes listed in Appendix C. These databases include diagnostic and procedure information for all health care services provided by VA. We searched all available diagnoses in each encounter to identify patients with any spine-related problem. NOTE, in VA up to 20 diagnoses can be included in outpatient data.

To characterize spine conditions as non-specific, we identified the first or incident spine pain event (inpatient admission or outpatient visit or encounter) for each patient in FY2002–2009 VA data, and identified those that would be excluded based on each of the diagnoses included in the “non-specific/mechanical” exclusion list (e.g. pregnancy related or due to infection or trauma). We also identified patients who had undergone a surgical or spinal procedure by procedure code.

Results

We identified 2.77 million unique patients who received care for neck and back problems in VA in fiscal years 2002 – 2009. Tables 2 and 3 demonstrate the results when each selection method was added to the previous algorithm for back pain and neck pain. For example, using the Cherkin and Deyo list alone, 2,129,984 unique individuals with back problems were identified in these data (Table 2). When we add the codes included in the HCUP Back category (205), we identify an additional 33,495 individuals, and when we add the HCUP sprains and strains diagnoses, we identify an additional 3,537 individuals. Finally, when we add the codes from the expanded Martin list another 3,750 individuals are identified. For the most part these differences are definitional, e.g. the Cherkin and Deyo study was about low back pain, which they defined as including thoraco-lumbar, lumbar, lumbo-sacral and sacral symptoms, but not thoracic alone and not coccygeal, while the HCUP back category and the Martin study include all spinal segments. Table 4 demonstrates the number of individuals identified using ICD-9 codes that are not segment specific.

Because several of the codes that were not spinal segment specific were included in both neck pain and back pain algorithms, we continued the analyses to further define whether a patient had neck pain or back pain. We selected those cases in which a code referring to a

non-specific spinal segment had served to identify the case for the cohort (e.g. in the incident event in these data) and searched for additional segment-specific codes in the first and subsequent encounters. (Table 5) We found that approximately 75 per cent of all cases included diagnoses referring to the back only, and 15 per cent referred to the neck only. The remaining 10 per cent included more than one area of the spine or combinations of codes for neck, back and non specific parts of the spine. Approximately 6.5 percent of cases included only non-specific codes.

Next, using the Cherkin and Deyo¹³ definitions, to identify patients with non-specific neck or low back pain, we excluded those cases “with a primary neoplastic, infectious, or inflammatory cause” and those “associated with pregnancy or major trauma”.^{13, 16} We identified the number of cases to be excluded if one of these conditions appeared in the data within one year prior to the first neck or back problem, and any years after. (Table 6) We included, “any years after” in order to control for potential prodromal conditions unidentified at first onset of the spine problem. Next, we examined the neoplasm exclusions. We hypothesized that, because diagnoses of primary skin and prostate cancers are common but rarely contribute to spine pain, and are either acutely treatable or slow-growing, asymptomatic, and non-metastatic, we removed the diagnoses for primary skin cancers (ICD-9 173.–173.9) and primary prostate cancer (ICD-9-185) from the exclusion list (NOTE exclusion of secondary malignant neoplasms - e.g. ICD codes 196–239.9- served to exclude those patients with cases of skin or prostate cancer that had advanced beyond the primary site). This served to reduce the number of cases excluded from the first step by 15 percent (from 1,000,709 cases excluded to 853,615 cases excluded). Also because administrative data that reflects health care encounters to “rule out” a diagnosis might include the diagnosis to be “ruled out”, we then demonstrated this potential effect by requiring each of the exclusionary conditions to appear in the data two or more times within 12 months⁴⁶. (Table 6) This second method reduced the number of cases to exclude due to pregnancy more than 83 percent, the number due to intraspinal abscess (324.1) and osteomyelitis, etc. (730.07–730.99) by approximately 45 per cent, and the number due to neoplasm (not including primary skin and prostate cancer) by one-third.

We next reviewed the algorithms used by the authors above ^{13, 14, 16, 17} to characterize hospitalizations as surgical and non-surgical, and these were straightforward. In these studies, once the spinal segment and the inclusion diagnoses had been defined, surgical and non-surgical hospitalizations were defined by the presence or not, of a limited list of ICD-9 surgery codes for spinal canal decompression, laminectomy, discectomy, fusion and refusion (ICD-9 codes 03.0, 03.02, 03.09, 03.6, 80.5, 80.50–80.52, 80.59, 81.0, 81.00–81.08, 81.3–81.39), excision of bone for graft (77.70 and 77.79) and insertion or removal of an internal fixation device or bone growth stimulator (78.50, 78.59, 78.60,78.69, 78.90,78.99). Because of changes in medical practice, and because some of these procedures might more recently be performed in an outpatient setting, we added appropriate CPT codes to this surgery list (CPT Surgery/Musculoskeletal System/Spine (Vertebral Column) CPT 22100–22865 and 62263 – 63710). We found that using the ICD codes alone we identified 36,724 patients who had undergone one of the spinal surgeries identified above, and adding the CPT codes, we identified a total of 46,615 patients, a 27% increase in the number of patients identified as having undergone a surgery or procedure. (See Appendix D for detail).

Discussion

We identified five papers published since Cherkin and Deyo¹³ that defined algorithms to identify patients with neck or back pain in administrative data. These methods, for the most part, are based on the algorithms developed by the Back Pain Outcomes Assessment Team (BOAT) for the study of back and neck pain.^{13, 14, 17} modified to address the questions of individual researchers. We found that there was overlap in the definitions of neck and back conditions and that it was necessary to clarify which spinal segments were included in each classification. In addition, we found that more than 204,000 cases in our 2002 – 2009 population were assigned a diagnosis in the first encounter that was not spinal segment specific, thus requiring additional analyses to specify the appropriate spinal segment.

We found consistency in the definitions of mechanical or non-specific spine pain (exclusion of neoplasm, infectious or inflammatory causes, pregnancy, trauma, etc.) and that requiring confirmation of an exclusionary diagnosis with a second encounter with that diagnosis reduced the number of cases excluded by 32–38 percent. We also determined that removing primary skin and prostate cancers from the neoplasm exclusions reduced the number of cases excluded by 147,094 individuals (14.7%). Finally, we determined that the addition of procedure codes to surgery algorithms had the potential to identify many more cases (in this case 275 more cases) to consider when analyzing surgery in more recent data.

Our findings suggest that, rather than code lists, the research community should adopt important technical guidelines for use in studies of neck and back pain using retrospective databases.²⁶ First, in order to enhance utility and comparability of results⁹, researchers should specify the focus of their research using anatomical references to describe neck and back pain. Second, if the researchers plan to include diagnosis codes that are not spine segment specific (e.g. ICD codes 721.90; 721.91; 722.2; 722.6; 722.70; 722.90; 738.4; and 847.9) they should confirm that these non-specific codes are associated with their segments of interest with additional exploration of the data. (For example, if the code used to select a patient is 721.9, *spondylosis of unspecified site without mention of myelopathy*, then the researcher should search forward in the data to determine if the preponderance of data reflected a neck or back condition.) Third, researchers should consider whether exclusionary diagnoses should be confirmed with at least two encounters and whether common conditions that rarely have impact on spine pain (for example, primary skin and prostate cancer) should be removed from exclusion lists. Fourth, researchers should use relevant diagnosis and procedure and surgery codes and both inpatient and outpatient data to identify the population of patients who receive spine related surgery and procedures. Additionally, to enhance comparability, researchers should report if they exclude any of the following conditions from their cohort: ankylosing spondylitis, etc (720.0–720.9); curvatures of the spine (737.0 – 737.9, excludes congenital); acquired spondylolisthesis and other acquired deformity of the back or spine (738.4–738.5); nonallographic lesions of the spine (739.1–739.4); anomalies of the spine (756.10–756.2); open/closed spinal fractures (805.0–806.9); and other vertebral dislocations (839.0–839.5). Finally, the research community should determine whether the above diagnostic groups should be included or excluded in analyses and reports of non-specific neck or back problems.

This study has several strengths that suggest that these recommendations will improve the validity and generalizability of studies which use this revised framework. First, the literature review identified 48 studies that reported using diagnosis and procedure codes to identify patients with neck and back conditions in administrative data. While the majority of these studies relied on the original algorithms developed by Cherkin and Deyo and the BOAT research group,¹³ consolidating the code list into a single table served to highlight the patterns of inclusion, exclusion and omission specific to each algorithm. This has provided an introduction to the scope of variation to be considered in defining a new framework. Second, we have tested these algorithms and assumptions in an extremely large administrative database. VA has been using an electronic health record for over ten years, and national compilations of longitudinal data have been used in this study. VA administrative data is comprehensive and includes inpatient, outpatient, ancillary and pharmaceutical care for a large population of Veterans (each year +/- 5 million Veterans receive health care services through the Veterans Health Administration). In addition, VA administrative data is routinely used to assess the quality and timeliness of care provided in VHA, and has been a primary resource for VA quality, safety and outcomes research.^{26, 47-49} As a result, testing the algorithms on such a large data set is unlikely to miss any important trends that might be present in smaller patient populations. Third, diagnosis and procedural coding activities are highly automated and professionalized in VA. This expertise is demonstrated in the frequency reports (Tables 2, 3 and 4) in which, as per correct coding conventions defined by the American Hospital Association, American Medical Association, the Centers for Medicare and Medicaid Services, and the National Center for Health Statistics, no patients are identified with three digit major codes, and no patients were identified with four digit subcodes if there was a five digit code available for more specificity (see Table 2, ICD-9 722.5, 722.51, 722.52). In VA, coding rules are integrated into the electronic data capture and all inpatient coding is done by credentialed experts. In practical terms, this means that diagnosis and procedure codes entered into the administrative data represent, in the most accurate way possible, the diagnoses, services and procedures received by an individual patient. In some cases, however, the professionalism in coding practice may also be a limitation, as it may not accurately reflect the errors produced in other environments where data entry is not automated or done by expert coders (for example see Stano and Smith).⁵⁰ Only further research can confirm what errors occur and what methods should be used for correction.

Our review of the algorithms used to identify patients with neck and back problems in administrative data suggest that an update to the most commonly used algorithm is warranted. This new methodology would have the researcher use international standards⁹ to define the spinal segment(s) of interest, confirm anatomical references when including diagnosis codes that are not segment specific, confirm the presence of excluding diagnoses in more than a single encounter of care, and would define surgical patients using both surgical and procedure codes from both inpatient and outpatient events of interest. This new framework also includes the recommendation for specificity in reporting on the spinal segment of interest and the conditions to be included and excluded from the analyses. This methodology is not limited to the use of CPT and ICD9 codes but is appropriate for use in any epidemiological or health services research which uses administrative data for the study

of neck and back pain conditions. With such a standardized methodology and reporting format, methodological variation in reports of the incidence, prevalence and outcomes of care can be minimized.

Acknowledgments

Funding for this study was provided by the VA Health Services Research and Development Service (HSR&D IIR 09-062) and was approved by the Stanford IRB and the VA Palo Alto Health Care Research and Development program.

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Appendix A: Pubmed Search Logic

Back and International Classification of Disease (ICD) and epidemiology; Neck and ICD and epidemiology; Back and ICD and surgery; Neck and ICD and surgery; Back and Common Procedure Terminology (CPT) and epidemiology; Neck and CPT and epidemiology; Back and CPT and surgery; and Neck and CPT and surgery. In addition we performed a search using a consolidation of the previous logic: ((“back pain”[MeSH Terms] OR (“back”[All Fields] AND “pain”[All Fields]) OR “back pain”[All Fields]) OR (“low back pain”[MeSH Terms] OR (“low”[All Fields] AND “back”[All Fields] AND “pain”[All Fields]) OR “low back pain”[All Fields]) OR (“neck pain”[MeSH Terms] OR (“neck”[All Fields] AND “pain”[All Fields]) OR “neck pain”[All Fields])) AND (cpt[All Fields] OR (common[All Fields] AND procedural[All Fields] AND terminology[All Fields]) OR icd[All Fields] OR icd9[All Fields] OR (international classification of diseases[All Fields]

OR international classification of diseases/classification[All Fields] OR international classification of diseases/economics[All Fields] OR international classification of diseases/history[All Fields] OR international classification of diseases/instrumentation[All Fields] OR international classification of diseases/standards[All Fields] OR international classification of diseases/trends[All Fields] OR international classification of diseases/utilization[All Fields])) AND ((“surgery”[Subheading] OR “surgery”[All Fields] OR “surgical procedures, operative”[MeSH Terms] OR (“surgical”[All Fields] AND “procedures”[All Fields] AND “operative”[All Fields]) OR “operative surgical procedures”[All Fields] OR “surgery”[All Fields] OR “general surgery”[MeSH Terms] OR (“general”[All Fields] AND “surgery”[All Fields]) OR “general surgery”[All Fields]) OR (“epidemiology”[Subheading] OR “epidemiology”[All Fields] OR “prevalence”[All Fields] OR “prevalence”[MeSH Terms])

APPENDIX B

Manuscripts reviewed in depth:

1. Cherkin DC, Deyo RA, Volinn E, Loeser JD. Use of the International Classification of Diseases (ICD-9-CM) to identify hospitalizations for mechanical low back problems in administrative databases. *Spine*. 1992;17(7): 817–825.
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APPENDIX C Inclusion and Exclusion lists consolidated

Body part	ICD-9 # or E-code	2009 ICD-9 Code Descriptions	Cherkin & Deyo '92 Inpt Hosp for LBP NHDS	HCUP Back	HCUP Sprains & Strains	Martin '08 Back and neck MEPS data	Taylor '98 Inpt for Back and neck Washington and Ontario	Einstadter '93 Inpt Neck Surgery Washington	Angevine '03 Inpt Neck Surgery NHDS
C	721.0	Cervical spondylosis without myelopathy	EXCL	INCL		INCL	INCL	INCL	INCL
C	721.1	Cervical spondylosis with myelopathy	EXCL	INCL		INCL	INCL	INCL	INCL
C	722.0	Displacement of cervical intervertebral disc without myelopathy		INCL		INCL	INCL	INCL	INCL
C	722.4	Degeneration of cervical intervertebral disc		INCL		INCL	INCL	INCL	INCL
C	722.71	Intervertebral disc disorder with myelopathy-cervical region		INCL		INCL	INCL	INCL	INCL
C	722.81	Postlaminectomy syndrome-cervical region		INCL		INCL	INCL	INCL	
C	722.91	Other and unspecified disc disorder-cervical region		INCL		INCL	INCL	INCL	INCL
C	723.0	Spinal stenosis of cervical region		INCL		INCL	INCL	INCL	INCL
C	723	Other disorders of the cervical region				INCL			
C	723.1	Cervicalgia		INCL		INCL	INCL	INCL	
C	723.2	Cervico-cranial syndrome		INCL		INCL	INCL	INCL	
C	723.3	Cervicobrachial syndrome (diffuse)		INCL		INCL	INCL	INCL	INCL
C	723.4	Brachial neuritis or radiculitis		INCL		INCL	INCL	INCL	
C	723.5	Torticollis, unspecified		INCL		INCL	INCL	INCL	
C	723.6	Panniculitis specified as affecting neck		INCL		INCL	INCL		
C	723.7	Ossification of posterior longitudinal ligament in cervical region		INCL		INCL	INCL	INCL	
C	723.8	Other syndromes affecting cervical region		INCL		INCL	INCL	INCL	
C	723.9	Unspecified musculoskeletal disorders and symptoms referable to neck		INCL		INCL	INCL	INCL	
C	738.2	Acquired deformity of the neck					INCL	INCL	
C	739.1	Non allopathic lesions cervical					INCL	INCL	
C	756.2	Congenital Anomalies of the Spine - cervical rib						EXCL	
C	784.0	Headache							
C	805.0	Closed cervical vertebral fractures without mention of spinal cord injury				INCL	EXCL		
C	805.1	Cervical fracture, open, without mention of spinal cord injury	EXCL			INCL	EXCL		
C	806.0	Cervical fracture, closed with spinal cord injury	EXCL			INCL	EXCL		
C	806.1	Cervical fracture, open with spinal cord injury	EXCL			INCL	EXCL		
C	839.0	Other, multiple, and ill-defined vertebral dislocations cervical vertebra, closed	EXCL			INCL	EXCL		
C	839.1	Other, multiple, and ill-defined vertebral dislocations cervical vertebra, open	EXCL			INCL	EXCL		
C	847.0	Sprains and strains of other and unspecified parts of back-neck			INCL	INCL	INCL	INCL	
T	721.2	Thoracic spondylosis without myelopathy	EXCL	INCL		INCL	INCL		
T	721.41	Thoracic spondylosis with myelopathy		INCL		INCL	INCL		
T	722.11	Displacement thoracic intervertebral disc without myelopathy		INCL		INCL	INCL		
T	722.31	Schmorl's nodes-thoracic region		INCL		INCL	INCL		
T	722.72	Intervertebral disc disorder with myelopathy-thoracic region		INCL		INCL	INCL		
T	722.82	Postlaminectomy syndrome-thoracic region		INCL		INCL	INCL		

Body part	ICD-9 # or E-code	2009 ICD-9 Code Descriptions	Cherkin & Deyo '92 Inpt Hosp for LBP NHDS	HCUP Back	HCUP Sprains & Strains	Martin '08 Back and neck MEPS data	Taylor '98 Inpt for Back and neck Washington and Ontario	Einstadter '93 Inpt Neck Surgery Washington	Angevine '03 Inpt Neck Surgery NHDS
T	722.92	Other and unspecified disc disorder-thoracic region		INCL		INCL	INCL		
T	724.01	Spinal stenosis, other than cervical-thoracic region		INCL		INCL	INCL		
T	724.1	Pain in thoracic spine		INCL		INCL	INCL		
T	737.0	Adolescent postural kyphosis				INCL			
T	737.10	Kyphosis (acquired)(postural)	INCL			INCL	INCL		
T	737.1	Kyphosis acquired				INCL			
T	737.11	Kyphosis due to radiation				INCL			
T	737.34	Thoracogenic scoliosis				INCL			
T	737.41	Curvature of the spine associated with other conditions, kyphosis				INCL			
T	739.2	Non alopathic lesions, thoracic							
T	805.2	Thoracic fracture, closed, without mention of spinal cord injury				INCL	EXCL		
T	805.3	Thoracic fracture, open, without mention of spinal cord injury	EXCL			INCL	EXCL		
T	806.2	Thoracic fracture, closed with spinal cord injury	EXCL			INCL	EXCL		
T	806.3	Thoracic fracture, open with spinal cord injury	EXCL			INCL	EXCL		
T	847.1	Sprains and strains of other and unspecified parts of back-thoracic			INCL	INCL			
TL	721.4	Thoracic or lumbar spondylosis with myelopathy				INCL	INCL		
TL	722.1	Displacement of thoracic or lumbar intervertebral disc w/o myelopathy	INCL			INCL	INCL		
TL	722.5	Degeneration of thoracic or lumbar intervertebral disc				INCL			
TL	722.51	Degeneration of thoracic or thoracolumbar intervertebral disc		INCL		INCL	INCL		
TL	724.00	Spinal stenosis - unspecified region	INCL	INCL		INCL	INCL		
TL	724.0	Spinal stenosis, other than cervical				INCL			
TL	724.09	Spinal stenosis, other than cervical-other	INCL	INCL		INCL	INCL		
TL	724.4	Thoracic or lumbosacral neuritis or radiculitis, unspecified	INCL	INCL		INCL	INCL		
TL	724.5	Backache, unspecified	INCL	INCL		INCL	INCL		
TL	839.2	Other, multiple, and ill-defined vertebral dislocations thoracic and lumbar vertebra, closed	EXCL			INCL	EXCL		
TL	839.3	Other, multiple, and ill-defined vertebral dislocations thoracic and lumbar vertebra, open	EXCL			INCL	EXCL		
L	721.42	Lumbar spondylosis w/o myelopathy	INCL	INCL		INCL	INCL		
L	722.10	Displacement of lumbar inter-vertebral disc w/o myelopathy	INCL	INCL		INCL	INCL		
L	722.32	Schmorl's nodes lumbar region	INCL	INCL		INCL	INCL		
L	722.73	Intervertebral disc disorder with myelopathy, lumbar region	INCL	INCL		INCL	INCL		
L	722.83	Postlaminectomy syndrome lumbar region	INCL	INCL		INCL	INCL		
L	722.93	Other and unspecified disc disorder, lumbar region	INCL	INCL		INCL	INCL		
L	724.02	Spinal stenosis, other than cervical-lumbar region	INCL	INCL		INCL	INCL		

Body part	ICD-9 # or E-code	2009 ICD-9 Code Descriptions	Cherkin & Deyo '92 Inpt Hosp for LBP NHDS	HCUP Back	HCUP Sprains & Strains	Martin '08 Back and neck MEPS data	Taylor '98 Inpt for Back and neck Washington and Ontario	Einstadter '93 Inpt Neck Surgery Washington	Angevine '03 Inpt Neck Surgery NHDS
L	724.2	Lumbago, low back pain, low back syndrome	INCL	INCL		INCL	INCL		
L	724.3	Sciatica	INCL	INCL		INCL	INCL		
L	737.2	Lordosis (acquired)				INCL			
L	737.2	Lordosis (acquired)(postural)				INCL			
L	737.21	Lordosis, postlaminectomy				INCL			
L	737.22	Other post surgical lordosis				INCL			
L	737.29	Lordosis acquired other				INCL			
L	737.42	Curvature of the spine associated with other conditions, Lordosis				INCL			
L	738.4	Acquired spondylolisthesis	INCL				INCL	INCL	
L	739.3	Nonallopathic lesions, lumbar region	INCL				INCL		
L	805.4	Lumbar fracture, closed, without mention of spinal cord injury	INCL			INCL	EXCL		
L	805.5	Lumbar fracture, open, without mention of spinal cord injury	EXCL			INCL	EXCL		
L	806.4	Lumbar fracture, closed with spinal cord injury	EXCL			INCL	EXCL		
L	806.5	Lumbar fracture, open with spinal cord injury	EXCL			INCL	EXCL		
L	847.2	Sprains and strains of other and unspecified parts of back-lumbar	INCL		INCL	INCL	INCL		
LS	721.3	Lumbosacral spondylosis w/o myelopathy	INCL	INCL		INCL	INCL		
LS	722.52	Degeneration of lumbar or lumbosacral intervertebral disc	INCL	INCL		INCL	INCL		
LS	724.8	Other symptoms referable to back	INCL	INCL		INCL	INCL		
LS	724.9	Other unspecified back disorders	INCL	INCL		INCL	INCL		
LS	756.11	Spondylolysis, lumbosacral region	INCL				INCL		
LS	846.0	Sprains and strains - lumbosacral (joint) (ligament)	INCL		INCL	INCL	INCL		
S	720.1	Spinal enthesopathy	EXCL	INCL		INCL	EXCL	EXCL	
S	720.2	Sacroilitis, not elsewhere classified	EXCL	INCL		INCL	EXCL	EXCL	
S	724.6	Disorders of sacrum	INCL	INCL		INCL	INCL		
S	739.4	Nonallopathic lesions, sacral region	INCL				INCL		
S	846	Sprains and strains of sacroiliac region				INCL			
S	846.1	Sprains and strains - Sacroiliac ligament	INCL		INCL	INCL	INCL		
S	846.2	Sprains and strains - acrospinatus (ligament)	INCL		INCL	INCL	INCL		
S	846.3	Sprains and strains - sacrotuberous (ligament)	INCL		INCL	INCL	INCL		
S	846.8	Sprains and strains - other specified sites of sacroiliac region	INCL		INCL	INCL	INCL		
S	846.9	Sprains and strains - unspecified site of sacroiliac region	INCL		INCL	INCL	INCL		
S	847.3	Sprains and strains of other and unspecified parts of back-sacrum	INCL		INCL	INCL	INCL		
SCX	805.6	Sacrum and coccyx fracture, closed, without mention of spinal cord injury				INCL	EXCL		
SCX	805.7	Sacrum and coccyx fracture, open, without mention of spinal cord injury	EXCL			INCL	EXCL		
SCX	806.6	Sacrum and coccyx fracture, closed with spinal cord injury	EXCL			INCL	EXCL		

Body part	ICD-9 # or E-code	2009 ICD-9 Code Descriptions	Cherkin & Deyo '92 Inpt Hosp for LBP NHDS	HCUP Back	HCUP Sprains & Strains	Martin '08 Back and neck MEPS data	Taylor '98 Inpt for Back and neck Washington and Ontario	Einstadter '93 Inpt Neck Surgery Washington	Angevine '03 Inpt Neck Surgery NHDS
SCX	806.7	Sacrum and coccyx fracture, open with spinal cord injury	EXCL			INCL	EXCL		
CX	724.70	Unspecified disorder of coccyx		INCL		INCL			
CX	724.7	Disorders of the coccyx				INCL			
CX	724.71	Hypermobility of coccyx		INCL		INCL			
CX	724.79	Disorders of coccyx-other		INCL		INCL			
CX	847.4	Sprains and strains of other and unspecified parts of back-coccyx			INCL	INCL			
	307.89	Psychogenic back pain	INCL				INCL		
	720	Ankylosing spondylitis and other inflammatory spondylopathies	EXCL			INCL	EXCL	EXCL	
	720.0	Ankylosing spondylitis	EXCL			INCL	EXCL	EXCL	
	720.8	Other inflammatory spondylopathies	EXCL			INCL	EXCL	EXCL	
	720.81	Other inflammatory spondylopathies in diseases classified elsewhere	EXCL	INCL		INCL	EXCL	EXCL	
	720.89	Other inflammatory spondylopathies - other	EXCL	INCL		INCL	EXCL	EXCL	
	720.9	Unspecified inflammatory spondylopathy	EXCL	INCL		INCL	EXCL	EXCL	
	721	Spondylosis and allied disorders				INCL			
	721.5	Spondylosis and allied disorders - Kissing Spine	INCL	INCL		INCL	INCL		
	721.6	Spondylosis and allied disorders - Ankylosing vertebral hyperostosis	INCL	INCL		INCL	INCL		
	721.7	Traumatic spondylopathy	INCL	INCL		INCL	INCL		
	721.8	Other allied disorders of the spine	INCL	INCL		INCL	INCL		
	721.90	Spondylosis of unspecified site without mention of myelopathy	INCL	INCL		INCL	INCL	INCL	
	721.9	Spondylosis of unspecified site				INCL			
	721.91	Spondylosis of unspecified site with myelopathy	INCL	INCL		INCL	INCL	INCL	
	722	Intervertebral disc disorders				INCL			
	722.2	Displacement of intervertebral disc, site unspecified, w/o myelopathy	INCL	INCL		INCL	INCL	INCL	
	722.30	Schmorl's nodes-unspecified region	INCL	INCL		INCL	INCL		
	722.3	Schmorl's nodes				INCL			
	722.39	Schmorl's nodes-other		INCL		INCL	INCL		
	722.6	Degeneration of intervertebral disc site unspecified	INCL	INCL		INCL	INCL	INCL	
	722.70	Intervertebral disc disorder with myelopathy-unspecified region	INCL	INCL		INCL	INCL	INCL	
	722.7	Intervertebral disc disorder with myelopathy				INCL			
	722.80	Postlaminectomy syndrome-unspecified region	INCL	INCL		INCL	INCL		
	722.8	Postlaminectomy syndrome				INCL	INCL	INCL	
	722.90	Other and unspecified disc disorder-unspecified region	INCL	INCL		INCL	INCL	INCL	
	722.9	Other and unspecified disc disorder site unspecified				INCL			
	724	Other and unspecified disorder of back				INCL			
	737	Curvature of the spine - excludes congenital				INCL			
	737.12	Kyphosis, postlaminectomy				INCL			

Body part	ICD-9 # or E-code	2009 ICD-9 Code Descriptions	Cherkin & Deyo '92 Inpt Hosp for LBP NHDS	HCUP Back	HCUP Sprains & Strains	Martin '08 Back and neck MEPS data	Taylor '98 Inpt for Back and neck Washington and Ontario	Einstadter '93 Inpt Neck Surgery Washington	Angevine '03 Inpt Neck Surgery NHDS
	737.19	Kyphosis acquired-other				INCL			
	737.30	Scoliosis [and kyphoscoliosis], idiopathic	INCL			INCL	INCL		
	737.3	Kyphoscoliosis and scoliosis				INCL			
	737.31	Resolving infantile idiopathic scoliosis				INCL			
	737.32	Progressive infantile idiopathic scoliosis				INCL			
	737.33	Scoliosis due to radiation				INCL			
	737.39	Other kyphoscoliosis and scoliosis				INCL			
	737.4	Curvature of the spine with other conditions				INCL			
	737.40	Curvature of the spine associated with other conditions, unspecified				INCL			
	737.43	Curvature of the spine associated with other conditions, Scoliosis				INCL			
	737.8	Other curvatures of the spine				INCL			
	737.9	Unspecified curvature of the spine				INCL			
	738.5	Other acquired deformity of the back or spine	INCL				INCL		
	756.10	Anomaly of spine, unspecified	INCL				INCL		
	756.12	Spondylolisthesis	INCL				INCL		
	756.13	Congenital anomalies of the spine - absence of a vertebra	INCL				INCL		
	756.14	Congenital anomalies of the spine - hemivertebra	INCL				INCL		
	756.15	Congenital anomalies of the spine - congenital fusion of the vertebrae	INCL				INCL		
	756.16	Congenital anomalies of the spine - Klippel-feil	INCL				INCL		
	756.17	Congenital anomalies of the spine - spina bifida occulta	INCL				INCL		
	756.18	Congenital anomalies of the spine	INCL				INCL		
	756.19	Congenital anomalies of the spine - other	INCL				INCL		
	805	Fracture of vertebral column without mention of spinal cord injury				INCL	EXCL		
	805.8	Vertebral fractures, unspecified closed, without mention of spinal cord injury	INCL			INCL	EXCL		
	805.9	Vertebral fractures, unspecified open, without mention of spinal cord injury	EXCL			INCL	EXCL		
	806	Fracture of vertebral column with spinal cord injury	EXCL			INCL	EXCL		
	806.8	Vertebral fractures, unspecified closed with spinal cord injury	EXCL			INCL	EXCL		
	806.9	Vertebral fractures, unspecified open with spinal cord injury	EXCL			INCL	EXCL		
	839.4	Other, multiple, and ill-defined vertebral dislocations, closed - other	EXCL			INCL	EXCL		
	839.5	Other, multiple, and ill-defined vertebral dislocations, open - other	EXCL			INCL	EXCL		
	847	Sprains and strains of other and unspecified parts of back				INCL			
	847.9	Sprains and strains of other and unspecified parts of back-unspecified	INCL		INCL	INCL	INCL	INCL	
	996.4	Mechanical complication of internal orthopedic device, implant and graft	INCL				INCL		
	03.2 - 03.29	Chordotomy (procedure)	EXCL						

Body part	ICD-9 # or E-code	2009 ICD-9 Code Descriptions	Cherkin & Deyo '92 Inpt Hosp for LBP NHDS	HCUP Back	HCUP Sprains & Strains	Martin '08 Back and neck MEPS data	Taylor '98 Inpt for Back and neck Washington and Ontario	Einstadter '93 Inpt Neck Surgery Washington	Angevine '03 Inpt Neck Surgery NHDS
	140–239.99	Neoplasms	EXCL				EXCL	EXCL	
	630–676.9	Pregnancy	EXCL				EXCL	EXCL	
	730.730.99	Osteomyelitis, periostitis, and other infections involving bone	EXCL				EXCL	EXCL	
	E800–E849.9	Transportation Accidents	EXCL					EXCL	

APPENDIX D Spine surgeries and procedures by year and code

ICD-9 Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
0302	Reopening of laminectomy site	67	60	104	78	114	122	138	110
0309	Other exploration and decompression of spinal canal	1748	2118	2194	2482	2772	2924	3039	3089
036	Lysis of adhesions of cord or nerve root	13	19	31	29	26	23	17	19
7770	Excision of bone for graft	8	10	20	10	5	10	59	107
7779	Excision of bone for graft	361	364	341	303	266	352	858	946
7869	Removal of internal fixation device (non-specific - vertebral, pelvic or phalangeal)	89	117	154	136	156	178	227	256
8050	Excision or destruction of intervertebral disc, unspecified	6	5	9	5	4	6	11	21
8051	Excision of intervertebral disc	2375	2583	2664	2808	2771	2990	3407	3381
8052	Intervertebral chemonucleolysis			2	2	1	1	4	1
8059	Other destruction of intervertebral disc	2	7	5	4	5	4	5	8
8100	Spinal fusion, not otherwise specified	21	25	33	15	24	21	24	20
8101	Atlas-axis spinal fusion	21	40	53	33	28	45	40	46
8102	Other cervical fusion, anterior technique	957	1098	1207	1254	1391	1449	1634	1691
8103	Other cervical fusion, posterior technique	190	243	272	306	358	407	485	478
8104	Dorsal and dorsolumbar fusion, anterior technique	29	31	27	27	38	26	36	29
8105	Dorsal and dorsolumbar fusion, posterior technique	56	58	79	87	134	116	143	134
8106	Lumbar and lumbosacral fusion, anterior technique	88	73	95	88	121	106	150	175
8107	Lumbar and lumbosacral fusion, lateral transverse process technique	56	80	61	60	60	86	96	135
8108	Lumbar and lumbosacral fusion, posterior technique	411	461	522	638	658	794	1145	1180
8109	Other spinal fusion	1							
8130	Refusion of spine, not otherwise specified	1		1	1		2		
8131	Refusion of atlas-axis spine	3		1		1		4	3

ICD-9 Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
8132	Refusion of other cervical spine, anterior technique	19	26	20	34	28	32	42	40
8133	Refusion of other cervical spine, posterior technique	6	7	18	14	19	33	32	38
8134	Refusion of dorsal and dorsolumbar spine, anterior technique			4		5	2	3	7
8135	Refusion of dorsal and dorsolumbar spine, posterior technique		4	6	3	7	8	14	17
8136	Refusion of lumbar and lumbosacral spine, anterior technique	3	1	5	12	2	7	11	12
8137	Refusion of lumbar and lumbosacral spine, lateral transverse process technique	5	1		3	2	5	8	5
8138	Refusion of lumbar and lumbosacral spine, posterior technique	22	17	29	35	41	53	57	95
8139	Refusion of spine, not elsewhere classified	2			1			1	2
ICD-9 Uniques = 42926		4430	4986	5236	5559	5857	6220	6971	7210

APPENDIX D Surgeries and Procedures by year and code

CPT Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
22100	Partial excision of posterior vertebral component (eg, spinous process, lamina or facet) for intrinsic bony lesion, single vertebral segment; cervical	2		1	12	3	1	2	2
22101	Partial excision of posterior vertebral component (eg, spinous process, lamina or facet) for intrinsic bony lesion, single vertebral segment; thoracic				1		2	1	
22102	Partial excision of posterior vertebral component (eg, spinous process, lamina or facet) for intrinsic bony lesion, single vertebral segment; lumbar		6			3	4	4	4
22103	Partial excision of posterior vertebral component (eg, spinous process, lamina or facet) for intrinsic bony lesion, single vertebral segment; each additional segment				1	13	5	4	1
22110	Partial excision of vertebral body, for intrinsic bony lesion, without decompression of spinal cord or nerve root(s), single vertebral segment; cervical	3		3		4	1	3	3
22112	Partial excision of vertebral body, for intrinsic bony lesion, without decompression of spinal cord or nerve root(s), single vertebral segment; thoracic		2	4					1
22114	Partial excision of vertebral body, for intrinsic bony lesion, without decompression of spinal cord or nerve root(s), single vertebral segment; lumbar	2	1	2	2				

CPT Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
22116	Partial excision of vertebral body, for intrinsic bony lesion, without decompression of spinal cord or nerve root(s), single vertebral segment; each additional vertebral segment			1	1	5		5	2
22206	Osteotomy of spine, posterior or posterolateral approach, three columns, one vertebral segment (eg, pedicle/vertebral body subtraction); thoracic							2	2
22207	Osteotomy of spine, posterior or posterolateral approach, three columns, one vertebral segment (eg, pedicle/vertebral body subtraction); lumbar							1	4
22208	Osteotomy of spine, posterior or posterolateral approach, three columns, one vertebral segment (eg, pedicle/vertebral body subtraction); each additional vertebral segment							2	3
22210	Osteotomy of spine, posterior or posterolateral approach, one vertebral segment; cervical	4	4	3	1	2			3
22212	Osteotomy of spine, posterior or posterolateral approach, one vertebral segment; thoracic	2	4	1	3	3		6	3
22214	Osteotomy of spine, posterior or posterolateral approach, one vertebral segment; lumbar	3	3	2	4	5	5	9	17
22216	Osteotomy of spine, posterior or posterolateral approach, one vertebral segment; each additional vertebral segment (List separately in addition to primary procedure)	1	2	2	4	8		9	11
22220	Osteotomy of spine, including discectomy, anterior approach, single vertebral segment; cervical	2	3	1	1	5	9	5	8
22222	Osteotomy of spine, including discectomy, anterior approach, single vertebral segment; thoracic	1				2		1	
22224	Osteotomy of spine, including discectomy, anterior approach, single vertebral segment; lumbar	6	5	5	2	3		4	4
22226	Osteotomy of spine, including discectomy, anterior approach, single vertebral segment; each additional vertebral segment		1	2	1	1	2	2	4
22305	Closed treatment of vertebral process fracture(s)	6	5	4	4	2	5	5	5
22310	Closed treatment of vertebral body fracture(s), without manipulation, requiring and including casting or bracing	8	8	17	19	17	21	30	22
22315	Closed treatment of vertebral fracture(s) and/or dislocation(s) requiring casting or bracing, with and including casting and/or bracing, with or without anesthesia, by manipulation or traction	72	53	5	5	5	10	6	2
22318	Open treatment and/or reduction of odontoid fracture(s) and or dislocation(s) (including os odontoideum), anterior approach,	3	4	1	2	7	9	6	7

CPT Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
	including placement of internal fixation; without grafting								
22326	Open treatment and/or reduction of vertebral fracture(s) and/or dislocation(s), posterior approach, one fractured vertebra or dislocated segment; cervical	5	6	3	15	10	11	14	14
22327	Open treatment and/or reduction of vertebral fracture(s) and/or dislocation(s), posterior approach, one fractured vertebra or dislocated segment; thoracic	7	11	5	10	13	13	17	13
22328	Open treatment and/or reduction of vertebral fracture(s) and/or dislocation(s), posterior approach, one fractured vertebra or dislocated segment; each additional fractured vertebra or dislocated segment	1	8	6	10	10	6	7	10
22505	Manipulation of spine requiring anesthesia, any region	3	2	3	8	6	9	7	21
22520	Percutaneous vertebroplasty, one vertebral body, unilateral or bilateral injection; thoracic	17	35	29	48	70	80	95	67
22521	Percutaneous vertebroplasty, one vertebral body, unilateral or bilateral injection; lumbar	33	39	28	53	66	117	124	133
22523	Percutaneous vertebral augmentation, including cavity creation (fracture reduction and bone biopsy included when performed) using mechanical device, one vertebral body, unilateral or bilateral cannulation (eg, kyphoplasty); thoracic					16	45	88	95
22524	Percutaneous vertebral augmentation, including cavity creation (fracture reduction and bone biopsy included when performed) using mechanical device, one vertebral body, unilateral or bilateral cannulation (eg, kyphoplasty); lumbar					25	80	109	133
22525	Percutaneous vertebral augmentation, including cavity creation (fracture reduction and bone biopsy included when performed) using mechanical device, one vertebral body, unilateral or bilateral cannulation (eg, kyphoplasty); each additional thoracic or lumbar vertebral body					7	24	40	42
22526	Percutaneous intradiscal electrothermal annuloplasty, unilateral or bilateral including fluoroscopic guidance; single level						3	39	31
22527	Percutaneous intradiscal electrothermal annuloplasty, unilateral or bilateral including fluoroscopic guidance; one or more additional levels						5	14	15
22590	Arthrodesis, posterior technique, craniocervical (occiput-C2)	3	4	2	6	8	5	6	4
22595	Arthrodesis, posterior technique, atlas-axis (C1-C2)	3	5	3	14	9	11	6	15
22600	Arthrodesis, posterior or posterolateral technique, single level; cervical below C2 segment	27	52	52	85	120	175	282	277

CPT Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
22610	Arthrodesis, posterior or posterolateral technique, single level; thoracic (with or without lateral transverse technique)	15	27	36	31	55	52	74	57
22612	Arthrodesis, posterior or posterolateral technique, single level; lumbar (with or without lateral transverse technique)	60	81	178	202	240	365	641	752
22614	Arthrodesis, posterior or posterolateral technique, single level; each additional vertebral segment	86	168	240	301	394	558	995	1076
22630	Arthrodesis, posterior interbody technique, including laminectomy and/or discectomy to prepare interspace (other than for decompression), single interspace; lumbar	22	57	100	125	149	212	440	479
22800	Arthrodesis, posterior, for spinal deformity, with or without cast; up to 6 vertebral segments	2		4	6	12		12	10
22802	Arthrodesis, posterior, for spinal deformity, with or without cast; 7 to 12 vertebral segments	4	6	2	1	3	2	10	11
22804	Arthrodesis, posterior, for spinal deformity, with or without cast; 13 or more vertebral segments				3				1
22818	Kyphectomy, circumferential exposure of spine and resection of vertebral segment(s) (including body and posterior elements); single or 2 segments	2				1		2	1
22819	Kyphectomy, circumferential exposure of spine and resection of vertebral segment(s) (including body and posterior elements); 3 or more segments					1		1	
22830	Exploration of spinal fusion	4	6	16	25	26	35	76	69
22840	Posterior non-segmental instrumentation (eg, Harrington rod technique, pedicle fixation across one interspace, atlantoaxial transarticular screw fixation, sublaminar wiring at C1, facet screw fixation)	41	52	69	115	144	164	378	409
22841	Internal spinal fixation by wiring of spinous processes	2	3	4	4	5	5	6	16
22842	Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 3 to 6 vertebral segments	73	121	204	229	319	424	664	708
22843	Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 7 to 12 vertebral segments	9	12	12	24	31	23	55	48
22844	Posterior segmental instrumentation (eg, pedicle fixation, dual rods with multiple hooks and sublaminar wires); 13 or more vertebral segments			2	5			1	1
22845	Anterior instrumentation; 2 to 3 vertebral segments	134	232	243	264	330	422	688	684
22846	Anterior instrumentation; 4 to 7 vertebral segments	15	30	34	42	74	83	112	93
22847	Anterior instrumentation; 8 or more vertebral segments	1			1	1	4	3	

CPT Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
22848	Pelvic fixation (attachment of caudal end of instrumentation to pelvic bony structures) other than sacrum			3	3	3		11	18
22849	Reinsertion of spinal fixation device		5	4	13	10	19	29	36
22850	Removal of posterior nonsegmental instrumentation (eg, Harrington rod)	3	3	5	5	9	11	27	22
22851	Application of intervertebral biomechanical device(s) (eg, synthetic cage(s), threaded bone dowel(s), methylmethacrylate) to vertebral defect or interspace	95	143	219	285	376	441	922	1081
22852	Removal of posterior segmental instrumentation	22	12	20	29	18	37	51	52
22855	Removal of anterior instrumentation	6	7	12	18	13	28	40	29
22856	Total disc arthroplasty (artificial disc), anterior approach, including discectomy with end plate preparation (includes osteophyctomy for nerve root or spinal cord decompression and microdissection), single interspace, cervical								28
22857	Total disc arthroplasty (artificial disc), anterior approach, including discectomy to prepare interspace (other than for decompression), single interspace, lumbar						2	12	14
22862	Removal of total disc arthroplasty (artificial disc), anterior approach, single interspace; cervical						1		
22865	Removal of total disc arthroplasty (artificial disc), anterior approach, single interspace; lumbar						1		1
CPT Uniques = 7890		383	500	559	617	890	1200	1910	2084

Key Points

Methods for identifying patients with neck and back problems in administrative data have not kept pace with changes in practice and coding.

A review of current methods suggests a new framework for identifying patients with neck and back pain in administrative data.

An updated framework to identify patients with neck and back pain in administrative data will help capture more cases for analyses.

Table 1

Comparison of Coding Algorithms

Author, Date	Title, Journal	Data source	Inclusion	Exclusions
Cherkin, Deyo, Volinn, Loeser, 1992	Use of the ICD-9-CM to Identify Hospitalizations for Mechanical Low Back Problems in Administrative Databases. <i>Spine</i>	National Hospital Discharge Survey	Low back (lumbo-sacral spine); Herniated disc; probable degenerative changes; spinal stenosis; possible instability; fractures; nonspecific backache; sequelae of previous surgery and miscellaneous. To identify surgical cases: 03.0;03.09;80.5; 80.50;80.51;80.52; 80.59;81.00;81.06;81.07;81.08 ; 81.09;03.6;03.02;78.69	<18 years old Neoplasms Intraspinal abscess; pregnancy; inflammatory spondyloarthropathies, osteomyelitis; open vertebral fractures with and without spinal cord injury, vertebral dislocations; motor vehicle accidents (E800–E849.9); chlordotomy (procedure 3.2–03.29); and cervical and thoracic fusions (81.01–81.03).
Volinn, Mayer, Diehr, Van Koeveering, Connell, Loeser, 1992	Small Area Analysis for Surgery for Low-Back Pain. <i>Spine</i>	Washington State Department of Health data set	Low-back: 721.3; 722.10; 722.52; 722.83; 724.2; 724.3; 738.4; 756.11; 756.12; 847.2 and procedure: 03.09; 80.5; 81.06; 81.07; 81.08	Problem other than lumbar; malignancy; trauma; infection stenosis.
Einstadter, Kent, Fihn, Deyo, 1993	Variation in the Rate of Cervical Spine Surgery in Washington State. <i>Medical Care</i>	Washington State - Comprehensive Hospital Abstract Reporting System	Cervical Spine: Herniated disc; degenerative changes; cervical spine stenosis; possible instability; miscellaneous neck disorders And procedures: 03.0;03.09;80.50;80.51;80.59; 81.00;81.01;81.02;81.08;81.09 ;03.603.02(as they pertain to cervical spine procedures)	<20 yrs old, neoplasms, spinal infection, acute trauma, inflammatory spondyloarthropathies, congenital anomalies of the cervical spine
Taylor, Anderson, McNaney, Diehr, Lavis, Deyo, Bombardier, Malter, Axcell, 1998	Hospitalizations for back and neck problems: a comparison between the Province of Ontario and Washington State. <i>Health Services Research</i>	Canadian Institute for Health Information Database And Washington State - Comprehensive Hospital Abstract Reporting System	Neck and Back; Cherkin Deyo for low back and Einstadter for neck. Both Surgical and Non-surgical cases (back = thoraco-lumbar; neck = cervical)	Neoplasms (140.0–239.9, 733.1) Infections (324.1;730.0–730.9) Inflammatory diseases (720.0–720.9) Pregnancy related conditions (630.0–676.9) and trauma (805.0–806.9, 839.0–839.5)
Angevine, Arons, McCormick, 2003	National and Regional Variation of Cervical Discectomy with and without anterior fusion 1990–1999. <i>Spine</i>	National Hospital Discharge Survey	Cervical spine: Own algorithm	<15 years old. Exclusions in non-surgical if surgery procedure performed.
Martin, Deyo, Mirza, Turner, Comstock, Hollingsworth, Sullivan, 2008	Expenditures and Health Status Among Adults with Back and Neck Problems. JAMA	Medical Expenditure Panel Survey	Neck and Back Major codes:720, 721, 722, 723, 724, 737, 805, 806, 839, 846, 847 and their subcodes.	<18 yrs; 733.13 pathologic fracture; Mechanical complication of internal orthopedic device, implant and graft; stiffness and arthralgia: because could not distinguish as related to spine or not. No procedure codes because MEPS data insufficient to identify many codes as related to spinal care.
HCUP Back		Multiple AHRQ databases	Category 205 spondylosis; intervertebral disc disorders; other back problems (includes all spine):720.1, 720.2, 720.81, 720.89, 720.9, 721.0, 721.1, 721.2, 721.3, 721.41, 721.42, 721.5, 721.6,721.7, 721.8, 721.90, 721.91, 722.0,722.10, 722.11, 722.2, 722.30, 722.31, 722.32, 722.39, 722.4, 722.51, 722.52, 722.6, 722.70, 722.71, 722.72, 722.73, 722.80, 722.81, 722.82, 722.83, 722.90, 722.91, 722.92, 722.93, 723.0, 723.1, 723.2, 723.3, 723.4, 723.5, 723.6, 723.7, 723.8, 723.9, 724.00, 724.01, 724.02, 724.09, 724.1,	

Author, Date	Title, Journal	Data source	Inclusion	Exclusions
HCUP Sprains and Strains		Multiple AHRQ databases	724.2, 724.3, 724.4, 724.5, 724.6, 724.7, 724.71, 724.79, 724.8, 724.9 Category 232 Sprains and strains (pertaining to the spine):840.0, 840.1, 840.2, 840.3, 840.4, 840.5, 840.6, 840.7, 840.8, 840.9, 841.0, 841.1, 841.2, 841.3, 841.8, 841.9, 842.00, 842.01, 842.02, 842.09, 842.10, 842.11, 842.12, 842.13, 842.19, 843.0, 843.1, 843.8, 843.9, 844.0, 844.1, 844.2, 844.3, 844.8, 844.9, 845.00, 845.01, 845.02, 845.03, 845, 845.10, 845.11, 845.12, 845.13, 845.19, 846.0, 846.1, 846.2, 846.3, 846.8, 846.9, 847.0, 847.1, 847.2, 847.3, 847.4, 847.9, 848.0, 848.1, 848.2, 848.3, 848.40, 848.41, 848.42, 848.49, 848.5, 848.8, 848.9, 905.7	

Table 2

Count of unique patients with back pain: sequential addition of patients by reference

ICD-9 #	Back Pain 2009 ICD-9 Code Descriptions	Cherkin & Deyo '92	HCUP Back	HCUP Sprains & Strains	Martin08 Back
720.1	Spinal enthesopathy		271		
720.2	Sacroilitis, not elsewhere classified		4,524		
721.2	Thoracic spondylosis without myelopathy		10,702		
721.3	Lumbosacral spondylosis w/o myelopathy	62,062			
721.4	Thoracic or lumbar spondylosis with myelopathy		470		
721.41	Thoracic spondylosis with myelopathy				
721.42	Lumbar spondylosis w/o myelopathy	1,597			
722.10	Displacement of lumbar inter-vertebral disc w/o myelopathy	16,616			
722.1	Displacement of thoracic or lumbar inter-vertebral disc w/o myelopathy				
722.11	Displacement thoracic intervertebral disc without myelopathy		702		
722.31	Schmorl's nodes-thoracic region		71		
722.32	Schmorl's nodes lumbar region	161			
722.5	Degeneration of thoracic or lumbar intervertebral disc				
722.51	Degeneration of thoracic or thoracolumbar intervertebral disc		4,930		
722.52	Degeneration of lumbar or lumbosacral intervertebral disc	84,079			
722.72	Intervertebral disc disorder with myelopathy-thoracic region		215		
722.73	Intervertebral disc disorder with myelopathy, lumbar region	1,837			
722.82	Postlaminectomy syndrome-thoracic region		85		
722.83	Postlaminectomy syndrome lumbar region	2,881			
722.92	Other and unspecified disc disorder-thoracic region		941		
722.93	Other and unspecified disc disorder, lumbar region	7,040			
724.00	Spinal stenosis - unspecified region	26,837			
724.0	Spinal stenosis, other than cervical				
724.01	Spinal stenosis, other than cervical-thoracic region		621		
724.02	Spinal stenosis, other than cervical-lumbar region	36,867			
724.09	Spinal stenosis, other than cervical-other	1,674			
724.1	Pain in thoracic spine				13,312
724.2	Lumbago	1,227,654			

ICD-9 #	Back Pain 2009 ICD-9 Code Descriptions	Cherkin & Deyo '92	HCUP Back	HCUP Sprains & Strains	Martin08 Back
724.3	Sciatica	74,352			
724.4	Thoracic or lumbosacral neuritis or radiculitis, unspecified	51,918			
724.5	Backache, unspecified	504,854			
724.6	Disorders of sacrum	2,862			
724.70	Unspecified disorder of coccyx		446		
724.7	Disorders of the coccyx				
724.71	Hypermobility of coccyx		20		
724.79	Disorders of coccyx-other		4,062		
724.8	Other symptoms referable to back	8,741			
724.9	Other unspecified back disorders	30,226			
737.0	Adolescent postural kyphosis				28
737.10	Kyphosis (acquired)(postural)	7,684			
737.1	Kyphosis acquired				
737.11	Kyphosis due to radiation	15			
737.2	Lordosis (acquired)				
737.20	Lordosis (acquired)(postural)	586			
737.21	Lordosis, postlaminectomy	5			679
737.22	Other post surgical lordosis	4			273
737.29	Lordosis acquired other	97			26
737.34	Thoracogenic scoliosis				
737.41	Curvature of the spine associated with other conditions, kyphosis				
737.42	Curvature of the spine associated with other conditions, Lordosis				
738.4	Acquired spondylolisthesis	2,526			
739.2	Nonallographic lesions, thoracic region				
739.3	Nonallographic lesions, lumbar region	1,573			
739.4	Nonallographic lesions, sacral region	828			
756.11	Spondylolysis, lumbosacral region	1,535			
805.2	Thoracic fracture, closed, without mention of spinal cord injury				2,499
805.3	Thoracic fracture, open, without mention of spinal cord injury				23
805.4	Lumbar fracture, closed, without mention of spinal cord injury				
805.5	Lumbar fracture, open, without mention of spinal cord injury	4,157			42

ICD-9 #	Back Pain 2009 ICD-9 Code Descriptions	Cherkin & Deyo '92	HCUP Back	HCUP Sprains & Strains	Martin08 Back
805.6	Sacrum and coccyx fracture, closed, without mention of spinal cord injury				516
805.7	Sacrum and coccyx fracture, open, without mention of spinal cord injury				17
806.2	Thoracic fracture, closed with spinal cord injury				
806.3	Thoracic fracture, open with spinal cord injury				
806.4	Lumbar fracture, closed with spinal cord injury				413
806.5	Lumbar fracture, open with spinal cord injury				39
806.6	Sacrum and coccyx fracture, closed with spinal cord injury				
806.7	Sacrum and coccyx fracture, open with spinal cord injury				
839.2-839.21	Other, multiple, and ill-defined vertebral dislocations, thoracic and lumbar vertebra, closed				83
839.3-839.31	Other, multiple, and ill-defined vertebral dislocations, thoracic and lumbar vertebra, open				2
846.0	Sprains and strains of the lumbosacral (joint) (ligament)	6,317			
846	Sprains and strains of sacroiliac region				
846.1	Sacroiliac ligament	724			
846.2	Sacrospinatus (ligament)	15			
846.3	Sacrospinous (ligament)	6			
846.8	Other specified sites of sacroiliac region	135			
846.9	Unspecified site of sacroiliac region	2,648			
847.1	Sprains and strains of other and unspecified parts of back-thoracic			3,704	
847.2	Sprains and strains of other and unspecified parts of back-lumbar	22,377			
847.3	Sprains and strains of other and unspecified parts of back-sacrum	253			
847.4	Sprains and strains of other and unspecified parts of back-coccyx			534	
	Unique Individuals	2,129,984	33,495	3,537	3,750

Table 3

Count of unique patients with neck pain: sequential addition of patients by reference

ICD-9 #	Neck Pain 2009 ICD-9 Code Descriptions	Einst93	Angevine '03	HCUP Back	HCUP Sprains & Strains	Martin08
721.0	Cervical spondylosis without myelopathy	51,201				
721.1	Cervical spondylosis with myelopathy	8,898				
722.0	Displacement of cervical intervertebral disc without myelopathy	8,129				
722.4	Degeneration of cervical intervertebral disc	36,439				
722.71	Intervertebral disc disorder with myelopathy-cervical region	2,921				
722.81	Postlaminectomy syndrome-cervical region	737				
722.91	Other and unspecified disc disorder-cervical region	4,592				
723.0	Spinal stenosis of cervical region	15,940				
723	Other disorders of the cervical region					
723.1	Cervicalgia	305,163				
723.2	Cervico-cranial syndrome	197				
723.3	Cervicobrachial syndrome (diffuse)	1,239				
723.4	Brachial neuritis or radiculitis	49,032				
723.5	Torticollis, unspecified	5,078				
723.6	Panniculitis specified as affecting neck			29		
723.7	Ossification of posterior longitudinal ligament in cervical region	59				
723.8	Other syndromes affecting cervical region	5,422				
723.9	Unspecified musculoskeletal disorders and symptoms referable to neck	2,952				
738.2	Acquired deformity of the neck					
739.1	Non allopathic lesions cervical	1,550				
805.0	Closed cervical vertebral fractures without mention of spinal cord injury					
805.1	Cervical fracture, open, without mention of spinal cord injury					57
806.0 – 806.09	Cervical fracture, closed with spinal cord injury					2
806.1–806.19	Cervical fracture, open with spinal cord injury					80
839.0–839.08	Multiple ill defined dislocations of the cervical vertebra, closed					2
839.1–839.18	Multiple ill defined dislocations of the cervical vertebra, open					
847.0	Sprains and strains of other and unspecified parts of back-neck	18,993				
	Unique Individuals	503,694		27		36

Table 4

Count of patients identified by codes that are not specific to spinal segment

ICD-9 #	Segment not specific 2009 ICD-9 Code Descriptions	Cherkin & Deyo '92	HCUP Back	HCUP Sprains & Strains	Martin08 Back
307.89	Psychogenic back pain	14,407			
720	Ankylosing spondylitis and other inflammatory spondylopathies				8,260
720	Ankylosing spondylitis				
720.8	Other inflammatory spondylopathies				
720.81	Other inflammatory spondylopathies in diseases classified elsewhere		296		
720.89	Other inflammatory spondylopathies - other		243		
720.9	Unspecified inflammatory spondylopathy		1,127		
721	Spondylosis and allied disorders				
721.5	Spondylosis and allied disorders - Kissing Spine	60			
721.6	Spondylosis and allied disorders - Ankylosing vertebral hyperostosis	433			
721.7	Traumatic spondylopathy	245			
721.8	Other allied disorders of the spine	4,645			
721.9	Spondylosis of unspecified site without mention of myelopathy	36,692			
721.91	Spondylosis of unspecified site				
721.91	Spondylosis of unspecified site with myelopathy	331			
722	Intervertebral disc disorders				
722.2	Displacement of intervertebral disc, site unspecified, w/o myelopathy	12,003			
722.3	Schmorl's nodes-unspecified region	51			
722.3	Schmorl's nodes	27			
722.39	Schmorl's nodes-other			20	
722.6	Degeneration of intervertebral disc site unspecified	57,671			
722.7	Intervertebral disc disorder with myelopathy-unspecified region	191			
722.7	Intervertebral disc disorder with myelopathy				
722.8	Postlaminectomy syndrome-unspecified region	520			
722.8	Postlaminectomy syndrome				
722.9	Other and unspecified disc disorder-unspecified region	5,011			
722.9	Other and unspecified disc disorder site unspecified				
724	Other and unspecified disorder of back				

ICD-9 #	Segment not specific 2009 ICD-9 Code Descriptions	Cherkin & Deyo '92	HCUP Back	HCUP Sprains & Strains	Martin08 Back
737	Curvature of the spine				
737.12	Kyphosis, postlaminectomy	10			
737.19	Kyphosis acquired-other	959			
737.3	Scoliosis [and kyphoscoliosis], idiopathic	13,900			
737.3	Kyphoscoliosis and scoliosis				11
737.31	Resolving infantile idiopathic scoliosis				2
737.32	Progressive infantile idiopathic scoliosis				4
737.33	Scoliosis due to radiation				1,633
737.39	Other kyphoscoliosis and scoliosis				
737.4	Curvature of the spine associated with other conditions				
737.4	Curvature of the spine associated with other conditions, unspecified				80
737.43	Curvature of the spine associated with other conditions, Scoliosis				362
737.8	Other curvatures of the spine				96
737.9	Unspecified curvature of the spine				368
738.5	Other acquired deformity of the back or spine	609			
756.1	Anomaly of spine, unspecified				
756.12	Spondylolisthesis	3,951			
756.13	Congenital anomalies of the spine - absence of a vertebra	11			
756.14	Congenital anomalies of the spine - hemivertebra	4			
756.15	Congenital anomalies of the spine - congenital fusion of the vertebrae	290			
756.16	Congenital anomalies of the spine - Klippel-feil	26			
756.17	Congenital anomalies of the spine - spina bifida occulta	489			
756.18	Congenital anomalies of the spine				
756.19	Congenital anomalies of the spine - other	883			
805	Fracture of vertebral column without mention of spinal cord injury				
805.8	Vertebral fractures, unspecified closed, without mention of spinal cord injury	4,382			
805.9	Vertebral fractures, unspecified open, without mention of spinal cord injury				23
806	Fracture of vertebral column with spinal cord injury				
806.8	Vertebral fractures, unspecified closed with spinal cord injury				116
806.9	Vertebral fractures, unspecified open with spinal cord injury				20
839.4-839.49	Other, multiple, and ill-defined vertebral dislocations, other vertebra, closed				202

ICD-9 #	Segment not specific 2009 ICD-9 Code Descriptions	Cherkin & Deyo '92	HCUP Back	HCUP Sprains & Strains	Martin08 Back
839.5–839.59	Other, multiple, and ill-defined vertebral dislocations, other vertebra, open				1
847	Sprains and strains of other and unspecified parts of back				
847.9	Sprains and strains of other and unspecified parts of back-unspecified	41,151			
996.4	Mechanical complication of internal orthopedic device, implant and graft	5,405			
	Unique Individuals*	204,357	1,686	0	11,178

* Not a column sum

Table 5

Count of patients by spinal segment diagnoses

Group	Patients
Back only	2,067,504
Neck only	420,745
Segment not-specified only	181,900
Back and Neck	76,363
Back and not-specified	25,566
Neck and not-specified	5,128
Back, Neck, and not-specified	1,914
Total	2,779,120

Table 6

Defining non-specific/mechanical back or neck pain (any occurrence by ICD-9 code, not sequential exclusion)

ICD-9 #	2009 ICD 9 Code Descriptions	Patients excluded with one encounter	Patients excluded with neoplasm list restricted	Patients excluded with two encounters	Patients excluded with two encounters: neoplasm restricted
324.1	Intraspinal abscess	1,613	1,613	884	884
733.1	Pathologic fracture	0	0	0	0
03.2 – 03.29	Chordotomy	115	115	3	3
140–239.99	Neoplasm all inclusive	1,000,709	---	715,351	---
173.0 – 173.9	Neoplasm of the skin	---	154,456	---	99,521
185–185.9	Neoplasm of the prostate gland	---	182,789	---	151,912
140–239.99	Neoplasm (not including primary neoplasm of the skin or prostate gland)	---	853,615	---	555,314
630–676.9	Pregnancy	14,787	14,787	2,482	2,482
730.0–730.99	Osteomyelitis, periostitis, and other infections involving bone	36,417	36,417	20,306	20,306
805 – 806	Vertebral fractures	18,611	18,611	1,040	1,040
E800–E849	Transportation Accidents	162,590	162,590	47,137	47,137
	Unique Individuals potentially excluded*	1,116,224	979,772	760,217	604,305

* Not a column sum