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Diagnostic testing and treatment of low back pain in US emergency departments. A national perspective

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Abstract

Study Design—This study is an analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS), a large sample representative of all emergency department (ED) visits throughout the US.

Objective—To use NHAMCS to describe the frequency of ED visits for the treatment of low back pain, and the diagnostic and therapeutic strategies employed by emergency clinicians.

Summary of Background Data—Low back pain is common in the general population. While it accounts for 2.5% of all outpatient office visits, the role of the Emergency Department has yet to be described.

Methods—We included cases if they had both a reason for visit related to back pain and a primary ED discharge ICD9 code consistent with low back pain. The outcomes included frequency of ED use, and frequency of various diagnostic and therapeutic strategies. Individual patient visits are weighted so that data can be extrapolated to all ED visits throughout the US.

Results—Low back pain related disorders caused 2.63 million (95%CI: 2.32, 2.93 million) annual ED visits in the US. 30.5% (28.1, 32.9%) of all low back pain patients had a plain radiograph. 9.6% (95%CI: 7.2, 12.6%) had a CT or MRI in 2006 compared with 3.2% (95%CI: 2.0, 5.1%) in 2002 (p for trend<0.01). Age and type of insurance were associated with advanced imaging, though geographic region was not. Of medications either administered in the ED or prescribed at discharge, the most frequently used classes were opioids (61.0%, 95%CI: 58.4, 63.5%), followed by non-steroidal anti-inflammatory drugs (49.9%, 95%CI: 47.2, 52.7%) and muscle relaxants (43.1%, 95%CI: 40.4, 45.8%).

Conclusions—Low back pain related disorders are a frequent cause of ED visit. Diagnostic imaging is performed in one-third of all patients. There was a strong secular trend in use of advanced imaging; patients were nearly three times as likely to receive a CT or MRI in 2006 as they were four years earlier. Although opioids were administered or prescribed to two-thirds of patients, use of therapeutic agents was generally in keeping with guideline recommendations.

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We analyzed a representative sample of emergency department (ED) visits throughout the US to describe the frequency of visits for the treatment of low back pain related disorders, and the diagnostic and therapeutic strategies employed. Low back pain related disorders are a frequent cause of ED visit. Diagnostic testing was performed in nearly half the patients. Use of therapeutic agents was generally in keeping with guideline recommendations.

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Keywords

low back pain; emergency department; national trends

Introduction

Low back pain is common in the general population. One-quarter of adults have at least one day of low back pain in a three month period[1] and most adults suffer low back pain at some point during their lives.[2,3] Direct and indirect costs for US payers are estimated in the tens of billions of dollars. [4,5] While low back pain accounts for approximately 2.5% of all office visits in the outpatient setting,[1,6] the role of the Emergency Department in the management of this condition has yet to be described.

The term mechanical low back pain describes a heterogeneous group of disorders attributable to the soft tissues and bony structures of the back.[7] A small percentage of patients have a specific anatomic cause of their back pain identified, such as a herniated intervertebral disc. Low back pain can also be caused by neuropathic or radicular pain. However, the majority of patients suffering from low back pain have injuries to the soft tissues of the back and a precise anatomic cause is never discovered. To encompass these various diagnoses, in this manuscript we will use the term “low back pain related disorders”. However, regardless of specific diagnosis, initial medical management of low back pain is the same, once infectious, malignant, neurologic, vascular, urologic, gynecologic, and rheumatologic etiologies of pain have been excluded.

A substantial evidence base exists to help determine optimal diagnostic strategies based on duration and severity of specific signs and symptoms.[8] Patients with low back pain of less than four weeks duration should not routinely receive imaging or other diagnostic tests. Laboratory testing is generally reserved for patients with unexplained back pain in whom malignancy or infection is suspected. Diagnostic imaging is indicated in patients with severe or progressive neurologic deficits or signs/ symptoms of a serious underlying condition. Patients with persistent low back pain and radicular signs or symptoms should be evaluated with advanced imaging (magnetic resonance imaging or computed tomography) to guide further management.

Treatment options for acute low back pain include non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen, skeletal muscle relaxants, opioids, and benzodiazepines[9]. High quality systematic reviews have been performed by the Cochrane collaboration, among others to help guide medical management. [10,11] For most patients with low back pain without radicular symptoms, acetaminophen or NSAIDs should be first-line agents. While skeletal muscle relaxants are more effective than placebo in treating low back pain, their role vis-a-vis opioid analgesics and NSAIDs is ill-defined[11]. Similarly, the role of systemic corticosteroids for radicular low back symptoms is ill-defined[12], though it is unlikely to be of benefit for non-radicular low back pain[13].

The purpose of this investigation was to describe the frequency of ED visits for the treatment of low back pain related disorders, and the diagnostic and therapeutic strategies employed by emergency clinicians in a nationally representative sample of ED visits.

Materials and methods

Study design

This study is a retrospective analysis of data from the National Hospital Ambulatory Medical Care Survey (NHAMCS), an annual survey in the US of nationally representative ED visits. The NHAMCS uses a multi-stage design that allows the total number of visits, diagnostic evaluations, and therapeutics initiated in all US EDs to be estimated. Data are collected by trained data abstractors who use the medical record to gather socio-demographic data as well as specific information about the visit. The methodology of NHAMCS is well described[14]. The NHAMCS data sets are publicly available at <http://www.cdc.gov/nchs/about/major/ahcd/nhamcsds.htm>. We included five years of data, from 2002 through 2006, because we believed this time period sufficiently long to detect recent secular trends in diagnosis and treatment. This study was administratively reviewed by the Montefiore Medical Center Institutional Review Board and determined to be exempt from IRB purview.

Study population

We included patient visits in our study if the reason for visit was related to back pain and the primary ED discharge ICD9 code was consistent with a low back pain related disorder. We used reason for visit in addition to the ED discharge code because NHAMCS diagnoses are not always precise as they rely on billing codes submitted by emergency practitioners. The reasons for visit used were: back symptoms (1905.0); low back symptoms (1910.0); back injury, including neck and vertebrae (5010.0); back strain (5110.0); and back injury: contusion, abrasion, bruise (5515.0). The diagnostic codes used were: inter-vertebral disc disorders (722); other and unspecified disorders of back (724); other disorders of soft tissues (729); sprains and strains of sacroiliac region (846); sprains and strains of other and unspecified parts of back (847); other and ill-defined sprains and strains (848); and injury, other and unspecified (959). From this population, we then excluded all patients who had a discharge diagnosis attributable to the cervical or thoracic back or spine. We did not include reasons for visit related solely to leg pain because we believed this would result in too heterogeneous a population of patients not suffering from low back pain. Radicular or disc-related low back pain was identified by the following ICD9 codes: 722, intervertebral disc disorder; 724.3, sciatica; and 724.4, thoracic/ lumbosacral neuritis/ radiculitis. We excluded all patients who had a motor vehicle collision injury code because we were primarily interested in patients with low back pain not associated with impact trauma. We only included patients 14 years of age or older because we felt younger children would be substantially different from the perspective of diagnostic modalities utilized and therapeutic strategies pursued, whereas those 14 and older were more likely to be diagnosed and treated similarly as adults.

Outcome Variables

The outcomes included frequency of ED use for low back pain related disorders, diagnostic tests performed, and therapeutic agents utilized. Diagnostic testing included complete blood count, creatinine, urinalysis, plain films, and advanced imaging including CT and MRI. Because until recently MRI was performed quite infrequently in the ED setting, CT and MRI are lumped together for most years of the NHAMCS. NHAMCS records up to eight classes of therapeutic agents administered in the ED or prescribed at discharge. For years 2002–2005, therapeutic agents administered or prescribed were assigned a code from the national drug code directory. For 2006, the Multum classification of therapeutic classes was used; this is a comprehensive proprietary database of all prescription and some nonprescription drug products available in the U.S. drug market. For the purpose of this analysis, a low back pain medication was considered an analgesic (including opioids, non-

steroidal anti-inflammatories, and acetaminophen), an anti-inflammatory (including non steroidal anti-inflammatories and corticosteroids), and muscle relaxants (including benzodiazepines and skeletal muscle relaxants).

Other variables included in the analyses were age, gender, type of insurance, length of stay and disposition.

Statistical Analyses

NHAMCS statistics were derived by a multistage estimation procedure that weights individual patient visits so that data can be extrapolated to all ED visits throughout the US. The procedure has four components: 1) inflation by reciprocals of the probabilities of selection, 2) adjustment for nonresponse, 3) a ratio adjustment to fixed totals, and 4) weight smoothing. This is described in more detail at

http://www.cdc.gov/nchs/ahcd/namcs_est_proc.htm. Data were aggregated and analyzed using the Complex Samples module of SPSS 17.0 (SPSS Inc., Chicago, Illinois). All analyses were performed using coding recommended by the National Center for Health Statistics. Frequencies and odds ratios are reported with 95% CIs. For logistic modeling, we entered and retained all of our empiric co-variates of interest in the model, regardless of p value.

Results

Over the five year period, NHAMCS recorded data from 183,633 individual patient visits. 4097 of the visits met our inclusion criteria. After accounting for sampling strategy, we determined that low back pain related disorders caused 2.63 million (95%CI: 2.32 million, 2.93 million) annual visits. This represents 2.3% (95%CI: 2.2, 2.4) of all visits to US EDs.

Of all low back pain related disorders visits, radicular or disc-related low back pain (intervertebral disc disorder; sciatica; or thoracic/ lumbosacral neuritis/ radiculitis) was coded by the emergency clinician in 6.6% (95%CI: 5.6, 7.8%) of visits. Other diagnostic codes are presented in Table 1.

Socio-demographic characteristics and characteristics of the ED visit are presented in Table 2. As ascertained from the medical record, 3.4% (95%CI 2.6, 4.4%) of patients had been seen in that particular ED over the previous 72 hours. 2.2% (95%CI: 1.7, 2.8%) of visits resulted in hospital admission.

Some type of diagnostic testing was performed in 45.1% (95%CI: 42.6, 47.6%) of the sample. Frequency of performance of specific diagnostic testing is listed in Table 3. Performance of MRI and CT scan was lumped together as one variable by NHAMCS in years 2002–2004. In 2005 and 2006, an MRI was performed on 2.8% (95%CI: 1.9, 4.2%) of patients with low back pain related disorders and a CT scan was performed on 5.5% (95%CI: 4.1, 7.2%). Plain films were more likely to be performed with every increasing decade of life (OR 1.18, 95%CI: 1.11, 1.25) as was a urinalysis (OR 1.12, 95%CI: 1.05, 1.19). There was a strong secular trend in advanced imaging: patients were almost three times as likely to have a CT or an MRI in 2006 (9.6% [95%CI: 7.2, 12.6%]) than in 2002 (3.2% [95%CI: 2.0, 5.1%]) (p for trend<0.01). After adjusting for secular trend, age and type of insurance were also associated with advanced imaging, though geographic region was not (Table 4).

Frequency of use of specific medications, and combinations of medications, is listed in Table 5. 9.3% (95%CI: 7.9, 11.0%) of patients received no medication for their low back pain. Patients who received a diagnosis of radicular or disc-related low back pain

(intervertebral disc disorder; sciatica; or thoracic/ lumbosacral neuritis/ radiculitis) were more likely to be treated with a corticosteroid than those who were not (OR 3.68 [95% CI: 2.30, 5.89]). Corticosteroids were administered to 13.9% (95% CI: 9.4, 20.1%) of patients who received these diagnoses and 4.2% (95% CI: 3.4, 5.3%) of those who did not.

Discussion

In this analysis of nationally representative data, low back pain related disorders were a frequent cause of emergency department visit, accounting for 2.7 million visits to US EDs annually. Diagnostic testing was performed in nearly one of every two low back pain patients and opioids were administered to nearly two-thirds of the sample. Although only a minority of patients with low back pain who seek medical care do so in an ED,[15,16] from the ED perspective, low back pain related disorders are an important cause of resource utilization because of visit frequency and the frequent performance of diagnostic testing. Similarly, ED visits for low back pain related disorders are an important source of healthcare costs. Using a median charge of \$299 per emergency visit, low back pain resulted in \$819 million in charges to US payers, a low estimate not including interpretation of diagnostic imaging.[17] Savings may be realized if visits can be shifted to primary care settings, where typical charges and propensity for diagnostic testing may be less.[18] It may be worthwhile for primary care providers to identify risk factors for an ED visit for low back pain. These include opioid use, younger age, and propensity for ED use for reasons other than low back pain.[19]

Non-specific diagnostic coding dominated this sample. Nearly two-thirds of our sample were given ICD9 code 724, a heterogeneous category including lumbago, sciatica, spinal stenosis, backache unspecified, and other unspecified back disorders. We were surprised by the relative infrequency of disc-related diagnoses. These accounted for 6.6% of the entire sample. Given the pain and disability associated with radicular symptoms, we would have expected a higher rate of disc-related diagnoses in the ED than in the general population. It may be that disc-related disease is relatively rare even in the ED setting. Alternatively, it may be that since initial management of non-disc related disease is similar to disc-related pain, the emergency clinicians did not see the need to differentiate, or simply failed to make the most accurate diagnosis

Diagnostic testing was performed often. Plain films were performed in nearly one third of patients. It is impossible to know from the NHAMCS database how many of these plain films were truly indicated: some of these patients may have had direct trauma to the back, longer duration of illness, or had other red flags for metastatic illness or other pathologic causes of back pain. The use of advanced imaging has increased dramatically in more recent years[20]. In the ED setting, this secular trend has been reported with other symptoms such as dizziness.[21] We can think of no reason why this occurred other than availability. As scanners become faster and more available, physicians have a lower threshold to order the test. Associations between advanced imaging and type of insurance are not surprising within the US healthcare system: this has been reported extensively in a variety of ways for a variety of medical ailments [22–24]. We were surprised that geographic variability did not exist, as this has been linked to overspending [25].

In general, medications administered were consistent with guideline recommendations. Opioids were often used, which is appropriate given the high rate of moderate and severe pain at triage. We were surprised that corticosteroids were not administered more frequently in patients with radicular or disc related diagnostic coding, though this is in keeping with standard recommendations.[9] Combination therapy was frequently employed. Data on this common practice is equivocal--adding a muscle relaxant or an opioid to a non-steroidal

may not result in increased efficacy. [26,27] Similarly, it is unknown whether an opioid or a muscle relaxant should be preferentially added to the non-steroidal, or if there is benefit for all three in combination. Given the frequency of these practices in this population, it is worthy of further study.

Limitations

As with all NHAMCS based studies, a limitation of this work is the diagnostic code assigned to the visit, which may not represent the patient's true diagnosis. We believe we used a reasonably rigorous methodology for identifying our patient population, but no doubt some patients with low back pain related disorders were missed, and some patients without a low back pain related disorder were included in the analysis. It is also difficult to analyze the appropriateness of the patient's work-up and the decision to obtain imaging or diagnostic tests without knowing the patient's history and physical exam. Some relevant data, such as duration of symptoms, are not available in NHAMCS. However, we believe, based on the benign diagnoses that were a prerequisite to inclusion in this study, and that few patients were admitted to the hospital, that too many imaging studies were performed. It is a limitation of this work that we cannot know this for certain. Some of this testing may have been indicated. In analyzing the medications administered to patients, we do not have information about patient allergies or intolerances, or whether the patient was already on a medication and was not getting relief, both of which may have altered the selection of a particular agent. We are also unable to draw conclusions about the efficacy of a particular treatment, as there is no information on recurrence of pain, return visits to the ED, or side effects. NHAMCS does not provide information on non-pharmacological treatment of low back pain; therefore we were unable to comment on the use of these modalities by emergency clinicians. Finally, the generalizability of these results is limited to patients who present to an ED in the US. These results cannot be extrapolated to the general population or the primary care setting.

In conclusion, low back pain related disorders are a frequent cause of ED visits. There was a tendency towards frequent testing, particularly in advanced ages and the well-insured. There was variability in treatment regimens, with most patients receiving more than one medication for acute low back pain. These data speak to the need for clinical trials that address relevant questions of combination therapy for acute low back pain.

Key points

- Low back pain is a frequent cause of emergency department visit
- Strong secular trend in use of advanced imaging in emergency departments between 2002 and 2006
- Opioids used in almost two-thirds of low back pain patients who present to an emergency department

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This study was administratively reviewed by the Montefiore Medical Center Institutional Review Board and determined to be exempt from IRB purview.

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Table 1

Physician's primary diagnosis among patients included in this analysis

ICD9 diagnosis	N	% (95%CI) after adjustment for NHAMCS sampling strategy
724 Unspecified back disorder	2614	63.5% (61.2, 65.7%)
724.2 Lumbago	1258	
724.3 Sciatica	156	
724.4 Thoracic or lumbosacral neuritis/ radiculitis	42	
724.5 Backache, unspecified	1065	
724.8 Other symptoms referable to back	66	
Other	27	
847 Sprain/strain back	845	21.7% (19.8, 23.7%)
847.2 Lumbar	607	
847.9 Unspecified	233	
Other	5	
(846) Sacroiliac sprains/ strains	256	5.4% (4.5, 6.4%)
846.0 Lumbosacral joint or ligament	124	
846.9 Unspecified	132	
848 Sprains/ strains	135	3.6% (2.8, 4.7%)
848.9 Unspecified site	129	
Other	6	
729 Soft tissue injury	100	2.4% (1.8, 3.1%)
729.1 Myalgia and myositis	72	
729.5 Pain in limb	21	
Other	7	
722 Intervertebral disc disorder	80	1.9% (1.4, 2.5%)
722.1 Displacement of thoracic or lumbar intervertebral disc without myelopathy	27	
722.2 Displacement of intervertebral disc, site unspecified, without myelopathy	23	
722.93 Other and unspecified disc disorder (lumbar)		
Other	10	
	20	
959 Injury	55	1.3% (0.9, 1.9%)
959.1 Trunk	15	
959.19 Other site on trunk	22	
Other	18	
721 Spondylosis and allied disorders	12	0.2% (0.1, 0.5%)
Total	4097	

Table 2

Characteristics of the included population

Characteristic	
Age in years (Median, IQR)	40 (30, 50)
Female	51.2% (49.4, 53.0%)
Expected source of payment	
Private insurance	36.1% (34.0, 38.3%)
Medicare	11.4% (10.2, 12.7%)
Medicaid/SCHIP	20.1% (17.8, 22.6%)
Workers compensation	7.5% (6.4, 8.7%)
Self-pay	21.6% (19.4, 24.0%)
No charge/ charity	1.4% (0.8, 2.6%)
Other	1.9% (1.4, 2.6%)
Geographic region	
Northeast	17.5% (14.1, 21.4%)
Midwest	22.8% (18.6, 27.6%)
South	43.9% (38.0, 50.0%)
West	15.8% (12.6, 19.7%)
Mode of arrival	
Ambulance	8.0% (6.8, 9.3%)
Public service	0.7% (0.4, 1.2%)
Walk-in	91.3% (89.9, 92.5%)
Episode of care for this chief complaint (n=2380)	92.8% (91.1, 94.2%)
Initial visit	7.2% (5.8, 8.9%)
Follow-up visit	
Presenting level of pain (n=2402)	
None	9.9% (8.0, 12.1%)
Mild	5.4% (4.0, 7.2%)
Moderate	30.6% (27.9, 33.4%)
Severe	54.2% (51.0, 57.3%)
Length of ED visit (median, IQR)	115 minutes (70, 186.8)

Public service: The patient arrives in a vehicle, such as a police car, a social service vehicle, beach patrol, etc., or is escorted or carried by a public service official

Table 3

Frequency of specific diagnostic testing within the population of all ED patients with low back pain related disorders.

Diagnostic test	N	% (95%CI)
Laboratory test		
Urinalysis	733	18.8% (17.0, 20.6%)
Complete Blood Count	419	9.7% (8.5, 11.1%)
Creatinine	225	5.2% (4.3, 6.3%)
Imaging		
Plain radiograph	1245	30.5% (28.1, 32.9%)
CT or MRI	267	6.1% (5.1, 7.1%)

Table 4

Receipt of CT or MRI. A multivariate logistic regression model to determine the influence of patient's age, year of visit, type of insurance, and region of the country

Variable	OR	95%CI
Age (years)	1.04	1.02, 1.05
Year		
2002	Reference	
2003	1.26	0.67, 2.37
2004	1.62	0.85, 3.07
2005	2.07	1.10, 3.88
2006	2.68	1.45, 4.95
Insurance		
Private insurance	Reference	
Medicare	0.62	0.36, 1.05
Medicaid/SCHIP	0.52	0.31, 0.87
Workers compensation	0.45	0.20, 1.04
Self-pay (Uninsured)	0.25	0.12, 0.51
No charge/charity	0.26	0.07, 0.96
Other	0.51	0.18, 1.47
Geographic region		
West	Reference	
Northeast	1.76	0.95, 3.26
Midwest	1.37	0.73, 2.60
South	1.35	0.75, 2.44

Table 5

Medications received within the population of all ED patients with low back pain related disorders.

Medication	N	% (95%CI)
Opioid	2481	61.7% (59.2, 64.2%)
Hydrocodone	1315	32.3% (30.0%, 34.6%)
Oxycodone	508	12.1% (10.3, 14.1%)
Meperidine	381	10.0% (8.7, 11.6%)
Hydromorphone	290	7.1% (5.8, 8.6%)
Morphine	253	6.4% (5.3, 7.6%)
Propoxyphene	165	4.9% (3.8, 6.1%)
Codeine	105	2.4% (1.8, 3.1%)
Nalbuphine	34	0.9% (0.5, 1.6%)
Butorphanol	26	0.8% (0.5, 1.4%)
Methadone	4	0.1% (0, 0.2%)
Non-steroidal anti-inflammatory	2066	49.5% (46.7, 52.3%)
Skeletal muscle relaxant	1704	42.8% (40.2, 45.4%)
Benzodiazepine	431	10.7% (9.3, 12.2%)
Corticosteroid	179	4.9% (3.9, 6.0%)
Acetaminophen	173	3.8% (3.0, 4.8%)
Medication combinations		
Non-steroidal anti-inflammatory + Skeletal muscle relaxant	1056	26.2% (23.9, 28.7%)
Non-steroidal anti-inflammatory + Opioid	1042	25.9% (23.8, 28.1%)
Non-steroidal anti-inflammatory + Benzodiazepine	226	5.6% (4.6, 6.8%)
Non-steroidal anti-inflammatory + Opioid + Skeletal muscle relaxant OR benzodiazepine	603	15.5% (13.9, 17.3%)