Clinical Studies

Spine coding transition from ICD-9 to ICD-10: Not taking advantage of the specificity of a more granular system ☆

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ABSTRACT

Background: The transition from International Classification of Diseases, 9th Edition (ICD-9) to the 10th edition (ICD-10) in 2015 increased the number and specificity of diagnostic codes with the goal of facilitating clinical care and research possibilities.

Considering the potential to default to less specified ICD-10 codes, the current study evaluated the number of codes utilized for spine-related conditions before versus after the transition to ICD-10.

Methods: The numbers of patients with an index encounter for a primary spine-related non-deformity diagnosis codes indexed as "dorsopathies" were abstracted from the Humana PearlDiver dataset. As the transition from ICD-9 to ICD-10 occurred in 2015, the current study compared the year prior (ICD-9) to the year after (ICD-10). The number of ICD-9 and ICD-10 codes was assessed, and distribution of utilization was compared using the Kolmogorov-Smirnov test.

Results:: In 2014, 848,623 patients were assigned one of the 100 unique ICD-9 dorsopathy codes, of which 17 codes (17% of available codes) were used for more than 1% of the patients. In 2016, 840,310 patients were assigned one of the 504 unique ICD-10 dorsopathy codes, of which 21 (4% of available codes) were used for more than 1% of the patients. The top 20 codes in 2014 (ICD-9) and the top 20 codes in 2016 (ICD-10) both represented the majority of the patient population and were not statistically differently represented ($p = 0.819$). Further, analysis of ICD-10 codes demonstrated a clear bias toward utilizing less specified codes.

Conclusions: Despite a five-fold increase in available diagnostic codes for spine conditions in ICD-10, in the year after implementation providers continued to select a small proportion of less specific diagnostic codes when treating spine patients.

Introduction

In 2015, the Centers for Medicare & Medicaid Services (CMS) of the United States Department of Health and Human Services implemented the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) as the official diagnostic tool for health care.[1,2] This marked a conversion from the previous ICD-9-CM, which had served as the primary diagnostic system since 1979.[1]

The conversion from ICD-9-CM to ICD-10-CM involved increasing the number and complexity of diagnostic codes to provide health caregivers with a greater degree of detail. While the ICD-9-CM codebook had approximately 14,000 distinct diagnostic codes, ICD-10-CM has more than 69,000 diagnostic codes.[1]

The Center for Disease Control and Prevention (CDC) highlighted the benefits of more enhanced data collection with the transition to ICD-10-CM. These improvements included more specific data for tracking public health conditions, conducting epidemiological research, as well as the potential for enhancing clinical decision-making and payment/reimbursement systems.[1,3] Although the CDC stated the intended advantages of the new classification system, only a few authors have published results assessing the improvements in data specificity and diagnostic coding since the conversion.[4-7]

In 2017, researchers using Veterans Affairs data analyzed the impact the conversion to ICD-10-CM had on the recording of the overall epidemiology of chronic conditions and mortality statistics.[8] Additionally, one group has evaluated the change in reimbursements and insurance denials associated with the conversion in an ophthalmology practice.[5] Both of these studies highlighted a tendency for coding to capture similar prevalence of conditions diagnosed; however, the ophthalmology study found a trend in which providers used a higher frequency of less

Table 1
Comparison of ICD-9 and ICD-10 diagnoses in study cohort.

ICD-9 codes	ICD-10 codes	Categories
720.XX – 721.XX	M45.XXX—M49.XXX	Spondylopathies
722.X1 – 723.XX	M50.XXX	Cervical Disc Disorders
722.X2, 722.X3, 724.X2, 722.X3	M51.XXX	Thoracic, Lumbar, Sacral Disc Disorders
722.X0 – 724.X0	M53.XXX	Other and Unspecified Dorsopathies
724.XX	M54.XXX	Dorsalgia

Cross-mapping of spinal conditions that comprise the category "Dorsopathies"; note that deformity codes are excluded from ICD-9 or ICD-10 groups.
ICD – International Classification of Diseases.

specific or unspecified codes upon conversion to the ICD-10 coding system.

Spine-related diagnosis codes are typically captured under a general heading of "dorsopathies". The diagnostic category of "dorsopathies" comprises all manner of pathologies originating from the back or neck. The category includes spondylopathies, deformities, disc disorders, radiculopathies as well as back and neck pain. The usage of different ICD-9 versus ICD-10 dorsopathy codes has not previously been reported in the literature.

The current study was thus performed to assess the hypothesis that, despite ICD-10 offering more diagnostic coding options/granularity for dorsopathy conditions than ICD-9, providers would continue to use a limited subset of available codes and would tend to default to less specific codes. The large national, administrative Humana dataset available from PearlDiver was used for these analyses.

Materials and methods

Data source

Data were extracted from the Humana patient subset from PearlDiver Patient Records Database (PearlDiver Inc., Colorado Springs, CO, USA), which captured diagnostic and reimbursement data from 5,497,415 patients in the years 2014 and 2016 cumulatively. This a national subscription database made available by PearlDiver Inc. for the purpose of academic orthopaedic research. The database is stored on a password-protected server maintained by PearlDiver Inc.

The database is searchable using ICD-9 or ICD-10 diagnoses. Our institutional Investigative Review Board has given exemption to studies utilizing this database.

Study cohorts

Using the ICD-9-CM diagnostic tables, codes were identified under the category "dorsopathies" containing spine (back or neck) as the primary origin or site of diagnosis. This encompassed every ICD-9 code from 720.XX to 724.XX (Table 1).

Corresponding ICD-10 codes were identified using the publicly available general equivalency mapping (GEM) files provided by CMS.[9] This encompassed codes M45.XXX – M54.XXX (Table 1).

All deformity codes were excluded from the current study cohort (ICD-9: 737.XX and ICD-10: M40.XXX – M43.XXX). Because the spine deformity coding has evolved to reflect additional stratifications based on age of onset and underlying disease state, the decision was made to exclude them from this analysis.

Using the PearlDiver Research Program, assessment was performed to identify patients who had one of the spine dorsopathy codes as the primary diagnosis in a clinical encounter in the respective years. Each diagnostic code analyzed was the primary diagnosis for an individual clinical encounter recorded in the insurance database. If a patient had multiple encounters during the assessed year, the earliest visit for the respective year was used as the encounter of record.

The study cohorts were also analyzed based on service encounter location. For service encounter location, four distinct locations were assessed as designated in PearlDiver – 1) Hospital & Surgical center, 2) Outpatient Clinic, 3) Skilled Nursing or Rehab Facility, 4) Emergency Room or Urgent Care. Analysis to determine the percentage of patients seen in each type of encounter location was performed to compare between years 2014 and 2016.

In 2014, the number of patients with the defined ICD-9 codes was assessed. In 2016, the number of patients with the ICD-10 codes was assessed. Demographic data of the two cohorts are listed in Table 2.

Subset analysis

A subset analysis was completed to illustrate the use of ICD-10 specificity. From the overall category of "dorsopathy" (M45-M54, 504 codes), the commonly used subset diagnoses that fall under "dorsalgia" (M54, 38 codes) were selected for in-depth analysis.

This subset analysis is to see whether the providers used specified codes when available. Diagnostic codes that were "unspecified" (denoting an unspecific entity when more specific codes are available) were compared to "specified" codes (denoting a specific anatomic region or sidedness). For example, the diagnostic code of M54.1 is "radiculopathy, site unspecified", and the diagnostic code of M54.16 is "radiculopathy, lumbar region." In this case, "radiculopathy, site unspecified" would be considered unspecified because there are more specific classifications available that clarify location, whereas "radiculopathy, lumbar region" would be considered specified because it captures the most specific description of radiculopathy diagnosis available. Within the category of "dorsalgia" there are 10 unspecified codes and 28 specified codes.

Statistical analysis

The utilization of ICD-9 and ICD-10 codes was determined. First, the overall number of patients with primary spine diagnoses was tallied. The number of diagnostic codes that were used for more than 1% of the total cases was then determined for the respective years.

Comparisons between the datasets to determine differences in distribution patterns were done using the two-sample Kolmogorov–Smirnov (K–S) test. This is a test that determines whether there is a statistically significant difference in distribution between the two samples. In comparing the two samples, a K–S Test p-value of < 0.05 would indicate a statistically significant difference in distribution between the samples, where a K–S Test p-value of > 0.05 would indicate no statistically significant difference.

Comparisons between the 2014 and 2016 cohorts with regards to encounter location were done using a Chi-squared test.

All summary statistics, distributions and calculations were performed using R, version 2.12.2 (R Development Core Team, Vienna, Austria).

Table 2
Cohort demographics.

Category	2014 ICD-9 Dorsopathy Cohort	2016 ICD-10 Dorsopathy Cohort
Total patients	848,623	840,310
% Female	59.50% (504,932)	59.94% (503,640)
Age		
Under 45 years	11.58% (98,271)	9.68% (81,342)
45–64 years	29.75% (252,465)	30.48% (256,126)
65+ years	58.67% (497,887)	59.84% (502,842)
Race		
White	56.50% (479,472)	61.84% (519,648)
Non-White	11.72% (99,459)	14.45% (121,425)
Unknown	31.78% (269,692)	23.71% (199,237)

Overview of cohort characteristics as reported in PearlDiver Patient Record Database reported as% (count).
ICD – International Classification of Diseases.
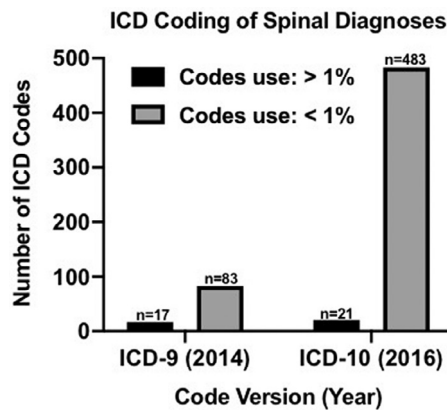
Fig. 1. ICD coding of spinal diagnoses.
This highlights the minority of available diagnostic codes used compared to the overall codes available. In 2014, 17 codes each accounted for greater than 1% of the total diagnostic volume (out of a possible 100 codes). In 2016, 21 codes each accounted for greater than 1% of the total diagnostic volume (out of a possible 504 codes).
ICD – International Classification of Diseases.

Fig. 2. ICD-9 vs. ICD-10 Code Utilization (Overall Plot).
This is a line plot of the frequency of individual code usage in ICD-9 and ICD-10. Note the similar overlay with a few diagnostic codes comprising the majority of percent total (*y*-axis) in both ICD-9 and ICD-10.
ICD – International Classification of Diseases.
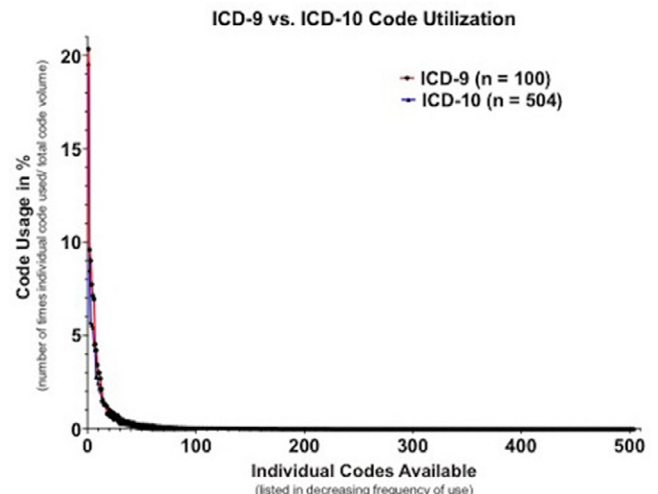
Results

Study cohorts

With ICD-9, there were 100 unique codes for "dorsopathy" (720.XX–724.XX). Within the 2014 Humana dataset, 848,623 patients had one of these codes as their primary diagnosis. Of the 100 unique ICD-9 codes, 17 codes (17% of available codes) were each utilized for more than 1% of the primary diagnoses (Fig. 1).

With ICD-10, there were 504 unique codes for "dorsopathy" (M45.XXX–M54.XXX). Within the 2016 Humana dataset, 840,310 patients had one of these codes as their primary diagnosis. Of the 504 unique ICD-10 codes, 21 codes (4% of available codes) were each utilized for more than 1% of primary diagnoses (Fig. 1).

Code distributions

For both ICD-9 and ICD-10 codes the majority of patients were assigned a small percentage of the available codes (Fig. 2). It can be noted in the distributions that the overwhelming majority of diagnoses were captured by a small number of codes.

To highlight the more commonly used codes, the 20 most-utilized codes from ICD-9 were compared to the 20 most-utilized codes from ICD-10 (Fig. 3). Use of the two- sample Kolmogorov-Smirnov test

demonstrated that the distributions of these codes were not statistically different (K-S Test p-value = 0.819).

Table 3 lists the 20 most-utilized codes from ICD-9 and ICD-10, respectively, with their percentage of use in the overall cohort.

The service encounter comparison from 2014 to 2016 demonstrated a similar proportion of visits to each of the designated location types. Although the Chi-squared test produced a statistically significant difference in each of the four location types from 2014 to 2016, this was likely due to a small difference in a large dataset comparison, and did not represent a meaningful difference between groups (Fig. 4).

Subset analysis

The most frequent ICD-10 coding prefix (M54.XXX – Dorsalgia) has 38 codes, of which there are 10 unspecified codes and 28 specified codes. The unspecified codes were 26.3% of the dorsalgia codes but were used for 71.8% of the dorsalgia encounters. The specified codes were 73.7% of the dorsalgia codes but were 28.2% of the dorsalgia encounters.

Discussion

The transition from ICD-9 to ICD-10 gave providers more coding options to facilitate clinical care and research. Specifically, the category

Table 3
Top 20 frequently used diagnostic dorsopathy codes, ICD-9 (2014) vs. ICD-10 (2016).

Rank	ICD-9 Diagnoses (2014) All Dorsopathy (720–724)	% of Total 100%	ICD-10 Diagnoses (2016) All Dorsopathy (M45-M54)	% of Total 100%
1	Lumbago (724.2)	20.35%	Low back pain (M54.5)	19.58%
2	Backache, unspecified (724.5)	9.60%	Cervicalgia (M54.2)	8.50%
3	Cervicalgia (723.1)	9.00%	Radiculopathy, lumbar region (M54.16)	5.70%
4	Degeneration of lumbar or lumbosacral disc (722.52)	7.74%	Other disc degeneration, lumbar region (M51.36)	5.56%
5	Thoracic or lumbosacral radiculitis, unspecified (724.4)	7.13%	Dorsalgia, unspecified (M54.9)	5.43%
6	Lumbosacral spondylosis without myelopathy (721.3)	6.94%	Spinal stenosis, lumbar region (M48.06)	4.53%
7	Displacement of lumbar disc without myelopathy (722.10)	4.52%	Spondylosis w/out myelopathy, radiculopathy, lumbar (M47.816)	4.24%
8	Spinal stenosis, lumbar, w/out neurogen. claudication (724.02)	4.21%	Other disc displacement, lumbar region (M51.26)	2.77%
9	Cervical spondylosis without myelopathy (721.0)	3.41%	Spondylosis w/out myelopathy, radiculopathy, cervical (M47.812)	2.76%
10	Degeneration of cervical intervertebral disc (722.4)	3.00%	Radiculopathy, cervical region (M54.12)	2.46%
11	Sciatica (724.3)	2.99%	Pain in thoracic spine (M54.6)	2.17%
12	Brachial neuritis/radiculitis, unspecified (723.4)	2.68%	Spondylosis w/out myelopathy, radiculopathy, lumbosacral (M47.817)	2.03%
13	Pain in thoracic spine (724.1)	2.13%	Radiculopathy, lumbosacral (M54.17)	1.55%
14	Displacement of cervical disc w/out myelopathy (722.0)	1.54%	Intervertebral disc disorders w/radiculopathy, lumbar (M51.16)	1.50%
15	Spinal stenosis in cervical region (723.0)	1.31%	Spinal stenosis, cervical region (M48.02)	1.48%
16	Sacroiliitis, not elsewhere classified (720.2)	1.27%	Other disc degeneration, lumbosacral (M51.37)	1.38%
17	Postlaminectomy syndrome, lumbar (722.83)	1.22%	Other cervical disc degeneration, unspecified cervical region (M50.30)	1.35%
18	Degeneration of disc, site unspecified (722.6)	0.80%	Sacroiliitis, not elsewhere classified (M46.1)	1.27%
19	Disorders of sacrum (724.6)	0.80%	Lumbago with sciatica, right side (M54.41)	1.13%
20	Spinal stenosis, unspecified region (724.00)	0.71%	Lumbago with sciatica, left side (M54.42)	1.06%

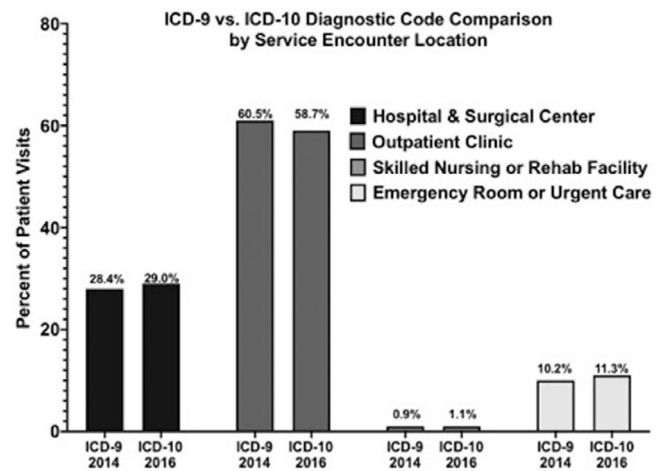*ICD - International Classification of Diseases.*
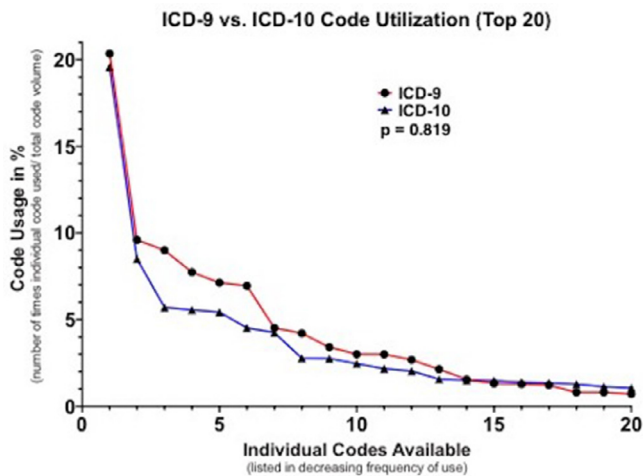
Fig. 3. ICD-9 vs. ICD-10 Code Utilization (Top 20 Codes).
A comparison plot of the top 20, highest volume diagnostic codes of ICD-9 and ICD-10. Analysis of empirical distribution (Kolmogorov–Smirnov Test) is applied to the two samples, a *p*-value of 0.819 demonstrates that the distributions are not statistically different. This means the overall pattern of common diagnostic code utilization is similar between ICD-9 and ICD-10 despite the availability of hundreds of more specific codes in ICD-10.
ICD- International Classification of Diseases.

Fig. 4. ICD-9 vs. ICD-10 diagnostic code comparison by service encounter location.
A graphical representation of the percentage of unique patient visits attributed to each of the four designated service encounter locations provided in PearlDiver between 2014 (ICD-9) and 2016 (ICD-10). While the Chi-squared test showed a statistically significant difference between the two groups in each location, the overall proportions were similar and represent no meaningful difference between groups.
ICD- International Classification of Diseases.

of dorsopathies increased in complexity from 100 possible diagnostic codes in ICD-9 to 504 possible diagnostic codes in ICD-10.

The current study found that the majority of diagnoses for dorsopathy spine conditions were captured by a small percentage of available codes, despite a five-fold increase in coding options with the transition from ICD-9 to ICD-10. In 2014, 17 diagnoses each accounted for utilization of more than 1% of the cumulative ICD-9 coding, while in 2016, 21 diagnoses each accounted for utilization of more than 1% of the cumulative ICD-10 coding.

Comparison of the top 20 diagnostic code volumes from ICD-9 and ICD-10 demonstrated two distributions that were not statistically significantly different. This showed that providers tended to use the same few codes with similar frequency both in ICD-9 and after the transition to ICD-10.

Not only did providers use a small fraction of available codes to account for the vast majority of diagnoses, they also tended to select non-specific diagnostic codes despite having more complex coding choices

available. This pattern highlighted by the example of the highest frequency category of dorsalgia (M54.XXX) codes, in which the 26.3% unspecified codes were used 71.8% of the time.

The current study is the first to evaluate utilization patterns of spine codes in ICD-10 versus ICD-9. Similar to the currently presented results, in radiology Fleming et al. demonstrated that radiology used a small percentage (less than 3%) of available ICD-10 codes for the overwhelming majority (90%) of radiology claim coding.[6] Also, in ophthalmology, Hellman et al. found that in an academic ophthalmology practice, the conversion to ICD-10 was associated with a bias toward unspecified codes.[5]

Consistent with the study hypothesis, the lack of usage of the full breadth of codes (number of codes and specificity of codes) is clearly a limitation to the objectives of introducing ICD-10. Clinical treatment algorithms cannot take advantages of the granular nature of ICD-10 if the specific codes are not used. Clinical research would have the similar limitations and lack of planned ICD-10 advantages.

There are several possible reasons that the breadth of codes afforded by ICD-10 was not taken advantage of. First and foremost, clinicians could be expected to default to codes that are similar to what they had used in the past. Although new coding options were made available, it is understandable that providers continue to rely on the same habit of coding they have been using for years of practice.

Electronic medical record systems may further facilitate physicians choosing pre-selected diagnoses or templates. Taking the time to change templated notes or poring through available codes may serve as barriers to change in the area of coding specificity. Without a targeted training / incentive, it is hard to imagine a significantly different pattern of code utilization for spine care going forward.

One opportunity to incentivize improvement in spine coding specificity exists with the new initiatives on reimbursements and bundled payments for spine care. Multiple studies outline the challenges in designing a bundled payment for spine surgery.[10-12] Kahn et al. note there is significant variation in spine surgeon preference and technique for the same coded procedure. However, this variation in provider preference may not account for as much difference in resource utilization as patient-level effects (comorbidities, demographics).[10]

In another study, Malik et al. highlighted the limitations of a bundled payment system demonstrating a wide range of costs for the same cervical fusion procedure.

In both of these studies, differences in patient diagnoses had a stronger association with cost of care than surgeon technique.[11] A bundled payment system that reimbursed based on preoperative diagnostic accuracy would likely result in providers utilizing more specific codes.

A strength of this study is its evaluation of a large private insurer database with millions of patient encounters. This allows for a robust depiction of diagnostic code usage for spine conditions. The samples used from the PearlDiver dataset are equitable in size and scope and therefore offer a valid comparison between ICD-9 in 2014 and ICD-10 in 2016.

There are limitations to the current study. First, the study is based on a single insurer (Humana), which may not be fully representative of coding seen by other insurers. Secondly, the study assessed the most recent data available for the current work, but it is possible that code usage has further evolved over the most recent few years. Additionally, as the study only evaluated primary diagnosis codes for billed encounters, it is possible that further granularity of secondary diagnoses was not appreciated. Nonetheless, given that the primary codes showed little change, it could be postulated similar trends occurred for secondary diagnoses.

Conclusion

Despite a five-fold increase in available diagnostic codes for spine conditions in ICD-10, immediately after implementation providers continue to select a small proportion of less specific diagnostic codes when caring for spine patients.

The ongoing initiatives in data registries and bundled care systems for spine care demonstrate an association between diagnostic accuracy and outcomes. Providers should take the opportunity to code for spine care in a manner that is accurate and specific in order to benefit from the additional clarity and granularity provided by ICD-10.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Funding disclosure statement

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.xnsj.2020.100035.

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