Comparison of medical comorbidities in Medicare patients treated by orthopaedic surgeons and neurosurgeons throughout the USA

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Aims
Medical comorbidities are a critical factor in the decision-making process for operative management and risk-stratification. The Hierarchical Condition Categories (HCC) risk adjustment model is a powerful measure of illness severity for patients treated by surgeons. The HCC is utilized by Medicare to predict medical expenditure risk and to reimburse physicians accordingly. HCC weighs comorbidities differently to calculate risk. This study determines the prevalence of medical comorbidities and the average HCC score in Medicare patients being evaluated by neurosurgeons and orthopaedic surgeon, as well as a subset of academic spine surgeons within both specialities, in the USA.

Methods
The Medicare Provider Utilization and Payment Database, which is based on data from the Centers for Medicare and Medicaid Services’ National Claims History Standard Analytic Files, was analyzed for this study. Every surgeon who submitted a valid Medicare Part B non-institutional claim during the 2013 calendar year was included in this study. This database was queried for medical comorbidities and HCC scores of each patient who had, at minimum, a single office visit with a surgeon. This data included 21,204 orthopaedic surgeons and 4,372 neurosurgeons across 54 states/territories in the USA.

Results
Orthopaedic surgeons evaluated patients with a mean HCC of 1.21, while neurosurgeons evaluated patients with a mean HCC of 1.34 (p < 0.05). The rates of specific comorbidities in patients seen by orthopaedic surgeons/neurosurgeons is as follows: Ischemic heart disease (35%/39%), diabetes (31%/33%), depression (23%/31%), chronic kidney disease (19%/23%), and heart failure (17%/19%).

Conclusion
Nationally, comorbidity rate and HCC value for these Medicare patients are higher than national averages for the US population, with ischemic heart disease being six-times higher, diabetes two-times higher, depression three- to four-times higher, chronic kidney disease three-times higher, and heart failure nine-times higher among patients evaluated by orthopaedic surgeons and neurosurgeons.

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Introduction
Medical comorbidities are a critical factor in the planning, execution, and outcomes of surgical procedures. Comorbidities such as obesity, diabetes, and immunosuppression have been identified as risk factors for surgical site infection in general arthroplasty patients.1 Similarly, the presence of multiple comorbidities has been shown to be predictive of major complications and poor outcomes in spine surgery patients.2,3 The presence of these conditions is ubiquitous and unavoidable in an ageing patient population. While there are multiple studies
showing a link between comorbidities and surgical complications, there is a paucity of data on the prevalence of these conditions specifically in patients evaluated by orthopaedic surgeons and neurosurgeons. Identifying this prevalence may assist in proper risk stratification, particularly with regard to recently established bundled care payment models, which have been critiqued by surgeons at tertiary academic medical centres for potentially not accounting for the higher costs of treating patients with multiple medical comorbidities.

The Hierarchical Condition Categories (HCC) model was introduced in 2004 as a means of adjusting Medicare capitation payments to private health care plans.\(^4\) HCC is utilized by Medicare to predict medical expenditures based on risk and to reimburse physicians accordingly when treating sicker patients. Li et al\(^5\) compared the performance of the HCC risk adjuster with the Charlson and Elixhauser comorbidity metrics and found that HCC was more effective in predicting in-hospital and six-month mortality. The HCC model considers a number of comorbidities of varying weights when calculating risk of treatment.\(^6\)

This study seeks to identify the prevalence of common comorbidities in Medicare patients who have an office visit with neurosurgeons or orthopaedic surgeons as well as a subset of patients evaluated by academic spine surgeons within each speciality. Utilizing the HCC model provides surgeons with a clear and concise single value which reflects the patient’s risk profile. This allows surgeons to quickly understand a patient’s degree of medical risk, particularly given the limited time restraints during clinic visits.

**Methods**

This study analyzed data from the Medicare Provider Utilization and Payment Database based on data from Centers for Medicare and Medicaid Services' (CMS’s) National Claims History Standard Analytic Files. This database contains 21,204 orthopaedic surgeons and 4,372 neurosurgeons in 54 US states and territories who submitted such claims. Surgeons included in the data set cared for approximately seven million unique Medicare beneficiaries. This database was cross-referenced with the 2013 Lumbar Spine Research Society (LSRS) membership, which includes both neurosurgery and orthopaedic spine surgeons. We are using LSRS surgeons as a proxy for academic spine surgeons. Every LSRS member surgeon who submitted a valid Medicare Part B non-institutional claim during the 2013 calendar year was included in this study. A total of 26 neurosurgeons and 76 orthopaedic surgeons who were members of the LSRS submitted a valid Medicare Part B non-institutional claim in 2013 and were included as well for our study. The prevalence of medical comorbidities and HCC scores of each patient seen by a surgeon were analyzed and averaged. Comorbidities included were ischemic heart disease (IHD), diabetes, depression, chronic kidney disease (CKD), and heart failure (HF).

**Statistical analysis.** HCC values for beneficiaries treated by orthopaedic surgeons and neurosurgeons were averaged and compared to national values with a t-test.

**Results**

For Medicare patients treated by orthopaedic and neurosurgeons, the nationwide prevalence of ischemic heart disease, diabetes, depression, chronic kidney disease, and heart failure was 35%/39%, 31%/33%, 23%/31%, 19%/23%, and 17%/19%, respectively (Table I). The average national HCC score for all patients is 1.0.\(^6\) Orthopaedic surgeons saw patients with an average HCC score of 1.21, while neurosurgeons saw patients with an average HCC score of 1.34 (p < 0.05), (Table II).

Substratification of patients evaluated by LSRS member surgeons were also analyzed for both neurosurgery and orthopaedic surgery members. LSRS orthopaedic surgeons and neurosurgeons saw patients who displayed a similar trend of comorbidities. For LSRS orthopaedic surgeons and LSRS neurosurgeons, the respective rates of prevalence for ischemic heart disease, diabetes, depression, chronic kidney disease, and heart failure were 34%/34%, 29%/29%, 27%/30%, 19%/20%, and 14%/16% respectively.

**Discussion**

This study demonstrates that Medicare patients who saw either orthopaedic surgeons or neurosurgeons have significant rates of medical comorbidities, which are higher than the general US population. The most commonly seen comorbidities encountered in the examined population were hypertension, hyperlipidemia, and osteoarthritis at rates of approximately 60%, 70%, and 65% respectively.

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**Table I. Comorbidities for patients seen by all orthopedic surgeons or neurosurgeons.**

| Comorbidity                  | Orthopaedic, % | Neurosurgery, % | National average, % |
|-----------------------------|----------------|-----------------|---------------------|
| Ischemic heart disease      | 35             | 39              | 6                   |
| Diabetes                    | 31             | 33              | 12 to 14            |
| Depression                  | 23             | 31              | 8                   |
| Chronic kidney disease      | 19             | 23              | 7                   |
| Heart failure               | 17             | 19              | 2                   |

*National average is Medicare population.

**Table II. HCC scores of Medicare patients treated by orthopedic surgeons or neurosurgeons.**

| HCC scores | Orthopaedic surgeon | Neurosurgeon | Weighted average |
|------------|---------------------|--------------|-----------------|
| General    | 1.21                | 1.34         | 1.23            |

HCC, Hierarchical Condition Categories.
Hypertension was documented at over 70% of Medicare patients studied. This value is significantly higher than the prevalence of hypertension in the US population as a whole, which is estimated to be 31%.7 In a similar fashion, diabetes was seen in 30% of the studied population, a prevalence over twice greater than the national rate of diabetes, which is 12% to 15%. Depressive disorder, which has been identified as an independent risk factor for poor outcome after spinal deformity surgery, was documented in nearly 30% of spine patients; while it is only present in 8% of the population as a whole.9,10

Chronic kidney disease has a prevalence of 7% in the Medicare population as a whole, but is found in nearly 20% of Medicare patients treated by either neurosurgeons or orthopaedic surgeons.11 It has been found that individuals with chronic kidney disease are at risk of increased morbidity after elective orthopaedic surgery.12 Furthermore, 2% of the national population suffer from heart failure, whereas a staggering 17% of patients seen by orthopaedic or neurological surgeons experience it. As of 2016, approximately 6% of the USA population suffered from ischemic heart disease.13 36% of Medicare patients seen by orthopaedic surgeons and neurosurgeons suffer from ischemic heart disease. Studies have demonstrated that orthopaedic patients with ischemic heart disease are at increased risk for postoperative cardiac complications.14 In fact, patients who received posterior spinal fusion are between 3.9- and 4.2-times more likely to develop myocardial injury when compared to total knee arthroplasty and total hip arthroplasty respectively. Patients of both orthopaedic and neurological surgeons experience comorbidities at a higher rate than the average population. These comorbidities are often associated with increased post-surgical morbidity.

The stratified patient population evaluated by academic spine surgeons who are members of the LSRS demonstrated no significant difference in HCC or comorbidity prevalence when compared to all orthopaedic surgeons and neurosurgeons.

Risks of intraoperative and perioperative complications during spine procedures tend to increase with age and the presence of comorbidities.15 Postoperative complications associated with comorbidity include increase risk of adverse event, morbidity, longer length of stay, and higher re-admission/re-operation rate.16 In addition to increased risk of complication, comorbidities substantially increase hospital costs for patients who undergo spine surgery. For example, Walid and Robinson17 found that hospital costs for spine surgery patients with both diabetes mellitus and depression were, on average, $13,533 more than patients without either of those conditions. With such an extreme prevalence of comorbidities in patients seen by orthopaedic surgeons and neurosurgeons, it is vital to improve our ability to manage these conditions in order to provide improved, cost-effective care. Thus, understanding the prevalence of comorbidities and HCC values in these Medicare beneficiaries may provide one of several tools in allowing surgeons to more objectively gauge the risk of each patient.

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