Follow us @BoneJointOpen

Freely available online OPEN ACCESS

BJO

GENERAL ORTHOPAEDICS

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

A. Beschloss,
J. Mueller,
J-M. E. Caldwell,
A. Ha,
J. M. Lombardi,
A. Ozturk,
R. Lehman,
C. Saifi

University of Pennsylvania, Philadelphia, USA

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.

Cite this article: *Bone Joint Open* 2020;1-6:257–260.

Keywords: Medicare, comorbidity, Hierachial condition categories, Neurosurgery, Orthopaedic Surgery

Correspondence should be sent to Comron Saifi, University of Pennsylvania, Philadelphia, United States; email: Comron.saifi@pennmedicine.upenn.edu

doi: 10.1302/2633-1462.16.BJO-2020-0032

Bone Joint Open 2020;1-6:257–260.

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 allow 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).

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.

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[5]. 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.

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%.[8] Depression, 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 substratified 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 Robinson[17] found that hospital costs for spine surge 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.

Twitter

@TheSpineSurgeon, @AmBeschloss

References

1. **Everhart JS**, **Altneu E**, **Calhoun JH**. Medical comorbidities are independent preoperative risk factors for surgical infection after total joint arthroplasty. *Clin Orthop Relat Res*. 2013;471(10):3112–3119.
2. **Smith JS**, **Shaffrey CI**, **Lafage V**, **et al**. Comparison of best versus worst clinical outcomes for adult spinal deformity surgery: a retrospective review of a prospectively collected, multicenter database with 2-year follow-up. *J Neurosurg Spine*. 2015;23(3):349–359.
3. **Raffo CS**, **Lauerman WC**. Predicting morbidity and mortality of lumbar spine arthrodesis in patients in their ninth decade. *Spine*. 2006;31(1):99–103.
4. **Pope GC**, **Kautter J**, **Ellis RP**, **et al**. Risk adjustment of Medicare capitation payments using the CMS-HCC model. *Health Care Financ Rev*. 2004;25(4):119–141.
5. **Li P**, **Kim MM**, **Doshi JA**. Comparison of the performance of the CMS hierarchical condition category (CMS-HCC) risk adjuster with the Charlson and Elixhauser comorbidity measures in predicting mortality. *BMC Health Serv Res*. 2010;10:245.
6. **Center for Medicare & Medicaid Services**. Fact Sheet:2015QURRs and the 2017 value modifier. 2017. https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PhysicianFeedbackProgram/Downloads/2015-RiskAdj-FactSheet.pdf
7. **Centers for Disease Control and Prevention (CDC)**. Vital signs: prevalence, treatment, and control of hypertension--United States, 1999-2002 and 2005-2008. *MMWR Morb Mortal Wkly Rep*. 2011;60(4):103–108.
8. **Menke A**, **Casagrande S**, **Geiss L**, **Cowie CC**. Prevalence of and trends in diabetes among adults in the United States, 1988-2012. *JAMA*. 2015;314(10):1021–1029.
9. **Vasiliadis H-M**, **Lesage A**, **Adair C**, **Wang PS**, **Kessler RC**. Do Canada and the United States differ in prevalence of depression and utilization of services? *Psychiatr Serv*. 2007;58(1):63–71.
10. **Ghoneim MM**, **O'Hara MW**, **O'Hara MW**. Depression and postoperative complications: an overview. *BMC Surg*. 2016;16:5.
11. **Stevens LA**, **Li S**, **Wang C**, **et al**. Prevalence of CKD and comorbid illness in elderly patients in the United States: results from the kidney early evaluation program (keep). *Am J Kidney Dis*. 2010;55(3 Suppl 2):S23–S33.
12. **Ackland GL**, **Moran N**, **Cone S**, **et al**. Chronic kidney disease and postoperative morbidity after elective orthopedic surgery. *Anesth Analg*. 2011;112(6):1375–1381.
13. **Sanchis-Gomar F**, **Perez-Quilis C**, **Leischik R**, **Lucia A**. Epidemiology of coronary heart disease and acute coronary syndrome. *Ann Transl Med*. 2016;4(13):256.
14. **Urban MK**, **Wolfe SW**, **Sanghavi NM**, **et al**. The incidence of perioperative cardiac events after orthopedic surgery: a single institutional experience of cases performed over one year. *Hss J*. 2017;13(3):248–254.
15. **Ciol MA**, **Deyo RA**, **Howell E**, **Kreif S**. An assessment of surgery for spinal stenosis: time trends, geographic variations, complications, and reoperations. *J Am Geriatr Soc*. 1996;44(3):285–290.
16. **Epstein NE**. Predominantly negative impact of diabetes on spinal surgery: a review and recommendation for better preoperative screening. *Surg Neurol Int*. 2017;8:107.
17. **Walid MS**, **Robinson JS**. Economic impact of comorbidities in spine surgery. *J Neurosurg*. 2011;14(3):318–321.

Author information:

- A. Beschloss, BA, Medical Student
- C. Saifi, MD, Assistant Professor of Orthopaedic surgery
  University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania, USA.
- J. Mueller, MD, Resident Physician in Orthopaedic Surgery
- J-M. E. Caldwell, MD, Resident Physician in Orthopaedic Surgery
- A. Ha, MD, Resident Physician in Orthopaedic Surgery
- J. M. Lombardi, MD, Comprehensive Spine Fellow
- R. Lehman, MD, Professor of Orthopedic Surgery
  Orthopaedic Surgery, Columbia University, New York, New York, USA.
- A. Ozturk, MD, Assistant Professor of Neurosurgery, Department of Neurological Surgery, University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania, USA.

Author contributions:
- A. Beschloss: Collected, analyzed and interpreted the data, Wrote the paper and carried out critical revision, Administrative.
- J. Mueller: Undertook conception and design, Extracted the data, Carried out critical revision and supervision.
- J-M Caldwell: Undertook conception and design, Carried out critical revision and supervision.
- A. Ha: Undertook conception and design, Carried out critical revision and supervision.
- J. M. Lombardi: Undertook conception and design, Carried out critical revision and supervision.
- A. Ozturk: Undertook conception and design, Carried out critical revision and supervision.
- R. Lehman: Undertook conception and design, Carried out critical revision and supervision.
- C. Saifi: Undertook conception and design, Carried out critical revision and supervision.

Funding statement:
- No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

ICMJE COI statement
- R. Lehman reports consultancy from Medtronic and Stryker Synthes Spine, and a Department of Defense Grant for research support, which are unrelated to this article. A. Ozturk reports consulting fee or honorarium from Depuy-Synthes, which was paid when the article was under consideration for publication. C. Saifi reports shares following the acquisition of Vertera by NuVasive and stock/stock options from Gilead, both of which are unrelated to this article.