Improved Risk Adjustment for Comorbid Diagnoses in Administrative Claims Analyses of Orthopaedic Surgery

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INTRODUCTION:

Unlike the controlled environment and homogeneous patient populations employed in most RCTs, claims data represent "real world" data from heterogeneous populations. Thus, claims analyses require thorough risk adjustment for patients' comorbid medical conditions. Many orthopaedic studies use only the diagnosis codes present on the index admission to identify comorbidities. However, information on coexisting medical conditions for inpatient admissions is often incomplete.

The goal of this study is to utilize the best practices in comorbidity adjustment developed in other clinical disciplines and apply this to an orthopaedic population, assessing improvements in capture rates, model fit, and explanatory power. We focus on the implementation of the Elixhauser comorbidity measure in elderly hip fracture populations from three types of claims resources: Medicare, all-payer, and private-payer.

METHODS:

Inpatient admissions for hip fracture were identified through ICD-9&10-CM codes. Patients with concurrent fractures or polytrauma were excluded. Comorbidities from the Medicare cohort (2009-2018 20% RIF sample) were captured from MedPar (inpatient) and the Outpatient/Carrier base files. Comorbidities from the all-payer (2016-2020 NY HCUP) cohort were captured from inpatient, ambulatory, and emergency department (ED) databases. Comorbidities from the private payer cohort (2016-2020 insurance database) were captured from the inpatient and outpatient databases.

Elixhauser comorbidities were identified first using only the codes present on the index admission. Additional captures were then performed using increasing amounts of data: first, including inpatient hospitalizations (year prior), and second, including outpatient encounters (year prior). For HCUP, an additional capture was performed using ED data. For a comorbidity to be present, one claim from inpatient data or ≥2 claims occurring ≥30 days apart from outpatient/ED data were required to avoid "rule out" or erroneous diagnoses. Explanatory and discriminatory power of the capture strategies were assessed for in-hospital (death, LOS, and total payments/charges) and post-discharge (90-day readmission, and 90-day and 1-year death [Medicare only]) outcomes via multivariable binary logistic regression and Generalized Estimating Equations. The model performance for each capture strategy was assessed with the Akaike information criterion (AIC),and the explanatory power was quantified by the area under the receiver operating characteristic curve (AUC).

RESULTS:

The final cohorts included 389,357 patients from Medicare, 47,383 patients from NY HCUP, and 86,776 patients from insurance database. The percentage of each class of Elixhauser comorbidity missed when including only data from the index admission ranged from 9.3% to 65.6% for the Medicare cohort, 2.9% to 39% for the NY HCUP all-payer cohort, and 14.7% to 57.9% for the private-payer cohort (Figure 1). When including data from the index admission + inpatient data from the year prior between 2.0% and 45% of comorbidities were still missed for Medicare versus using all available data (0.2% to 8.5% for NY HCUP, and 2.9% to 40.0% for insurance database). The gains in capture rates with the inclusion of outpatient data from Medicare and insurance database were much greater than those achieved with the NY HCUP outpatient data, as the latter includes only claims from ambulatory surgery centers. Inclusion of ED data provided only 0.0% to 1.1% improvements in capture rates. For post-discharge metrics, the inclusion of inpatient and outpatient data from the year prior led to significant improvements in model performance ($p < 0.001$) in all cohorts (Table 1). For in-hospital death and LOS metrics, the comorbidities contained within the index admission, alone, provided the best model fit and explanatory power for all cohorts. For total inpatient payments/charges for the index hip fracture admission, the results were mixed, with the best explanatory power for the Medicare cohort resulting from all available data, whereas for the HCUP and insurance cohorts, the comorbidities captured on the index admission were sufficient.

DISCUSSION AND CONCLUSION:

Many comorbidities are missed when including only data from the index inpatient admission. The addition of inpatient and outpatient data from the year prior substantially improved the capture rate of Elixhauser comorbidities for Medicare and private payer data. For the all-payer NY HCUP data, inpatient data from the year prior substantially improved capture rates. However, data from ambulatory surgery centers and EDs provided only modest improvements. The inclusion of inpatient and outpatient data from the year prior provided substantive improvements in model performance and explanatory power for post-discharge outcomes in all cohorts. However, for in-hospital metrics, comorbidities captured on the index admission were most consequential and adding data from the year prior provided little to no improvement in model performance or explanatory power. In conclusion, our results support using all available data from the year prior wherever possible when capturing comorbidities for risk-adjusted modeling of post-discharge outcomes. These results also have significant implications for risk adjustment of quality metrics defined from claims data.

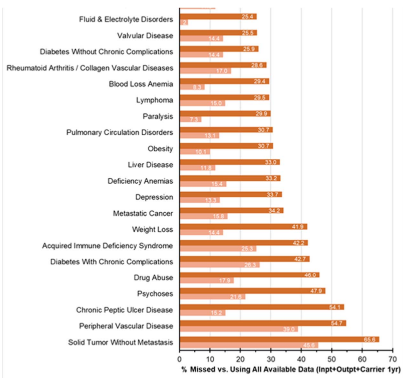

Figure 1. *Percentage of comorbidities missed when using index data only and index+inpatinet data from the year prior to admission versus using all available data (index + inpatinet + outpatient/carrier) from the year prior to admission from the Medicare cohort.*

Table 1. *Model fit (lower AIC, significant improvement ≥2 point reduction) and explanatory power (higher AUC) for the different comorbidity capture strategies.*

			In-Hospital Metrics				Post-Discharge Metrics					
Cohort & Capture Strategy			In-Hospital Death		LOS	Total Payments or Charges for Index Admission	90d All-Cause Readmission		90d Death		1yr Death	
			AIC	AUC	AIC	AIC	AIC	AUC	AIC	AUC	AIC	AUC
Medicare	No Comorbidities		85361	0.641	1804217	7391731	361892	0.558	309424	0.651	16276	0.650
	Index Only		**79464***	**0.764***	**1755923***	7387488	357956	0.596	290305	0.733	16037	0.697
	Inpt 1yr		80016	0.759	1763829	7387802	355255	0.613	290275	0.736	15998	0.705
	Inpt + Outpt + Carrier 1yr	2-cat	80069	0.758	1765521	**7386374***	**352190***	**0.631***	**290188***	**0.736***	**15986***	**0.707***
HCUP	No Comorbidities		10481	0.643	243045	1133443	52079	0.560				
	Index Only		**9345***	**0.807***	**236161***	**1128675***	51537	0.594				
	Inpt 1yr		9462	0.805	237018	1129235	51363	0.601				
	Inpt + Outpt 1yr		9459	0.805	237035	1129281	51346	0.602				
	Inpt + Outpt + ED 1yr	2-cat	9461	0.805	237034	1129283	**51340***	**0.602***				
Marketscan	No Comorbidities		2538	0.684	429582	1919583	61279	0.589				
	Index Only		**2453***	**0.805***	**423590***	**1917791***	60064	0.638				
	Inpt 1 yr		2481	0.790	423181	1918021	**59347***	0.654				
	Inpt + Outpt 1yr	2-cat	2496	0.782	423384	1918100	59350	**0.655***				

* Best-performing 2-category comorbidity capture strategy for each outcome