Applying a Market-Basket Analysis to Reduce Variability and Increase Coding Frequency of Procedure Codes among Surgeons

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Abstract
This research is a proof-of-concept application of a market-basket analysis to identify procedure codes associated with particular diagnoses codes. The objective is to develop a recommender system to aid clinicians by increasing coding frequency and reducing variability. We conducted a case study using a total of 6,023 coded diagnoses (810 distinct codes) and 3,435 procedure codes (300 distinct procedures) for a total of 3,879 encounters derived from electronic medical records for a vascular surgeon in the Military Health System for the years 2015-2017. The top 10 diagnosis codes consisted of more than 30% of all the diagnoses coded while the top 10 procedure codes represented over 60% of all the procedures.

Description of the Problem
A conservative estimate of the number of surgeries that go uncoded at Brooke Army Medical Center (BAMC) is 40 - 60%. Given the Department of Surgery accounts for approximately 30% of BAMC’s annual production value, the under coding of surgical procedures results in significant productivity loss as well as an inaccurate representation of surgeons’ readiness skills.

Purpose of the Project
Our objective is to conduct a market-basket analysis of the procedural codes associated with particular diagnoses codes to increase coding frequency and reduce coding variability among surgeons in the Military Health System (MHS). This proof-of-concept will demonstrate the potential for adoption as a clinical decision support tool for surgeons at BAMC and across the MHS.

Methods
For this proof-of-concept, we analyzed one physician’s encounters from Jan to Dec in 2015-2017, resulting in 6,023 procedure codes and 3,435 diagnoses codes from a total of 3,879 encounters. We tested different thresholds to determine the optimal number of association rules while evaluating their clinical relevance. To demonstrate the economic value of this technique, we considered the difference in Relative Value Units (RVUs) of improving coding frequency among physicians. Likewise, the same methods will be applied to the MHS Purchased Care records to evaluate the association rules compared to those derived from the Direct Care System.

Results
The top 10 diagnosis codes consisted of more than 30% of all the diagnoses coded while the top 10 procedure codes represented over 60% of all the procedures. The case study indicated 43.8% under-coding of the work RVUs, for a difference of approximately 177 RVUs (592 in actuality compared to the credited 412). Improving coding frequency using a clinical decision support tool could have potentially resulted in approximately an additional 1,597 RVUs.

Conclusions
This research indicates implementing a market-basket analysis as a recommender system of CPT codes would yield large economic returns and be profitably adopted by other departments and MHS-wide. Future research should validate these results on a larger sample, however, before implementing as a clinical decision support tool.