Improving Emergency Department Utilization Risk Scoring.

Jason Mose, Ph.D., MBA, MS, CHFP
Department of Health Services & Information Management

BACKGROUND

In the last decade, the healthcare sector experienced progressive transformation towards more patient and family-centered care. One of the underpinnings of the transformation is the movement from the volume driven fee-for-service payment system to a value-based payment system. Also, the healthcare delivery system saw the rise of new care delivery models such as the Accountable Care Organizations(ACO)[1]. ACOs for example, incentivizes providers to coordinate care to ensure that patients, “especially the chronically ill, get the right care at the right time, with the goal of avoiding unnecessary duplication of services and preventing medical errors.”[1]

ACOs have shown promise in improving outcomes and reducing overall expenditure, areas of interest to the payers[2]. However, there is still a struggle to sustainably drive better patient outcome and reduce improper or unnecessary utilization. One of the existing gaps is that the risk scoring, some built internally and used in some settings have not been subjected to statistical testing to evaluate how accurate they are. A review of best practices among ACOs indicates “high-performing ACOs employ a data-driven approach and use analytics extensively, including to carry out risk stratification, identify gaps in care, improve care coordination, and enhance patient engagement.”[2] This improvement project is an attempt to improve the emergency department risk scoring system among Medicare patients with the view to identifying patients at high risk of avoidable emergency department utilization.

PROJECT AIM

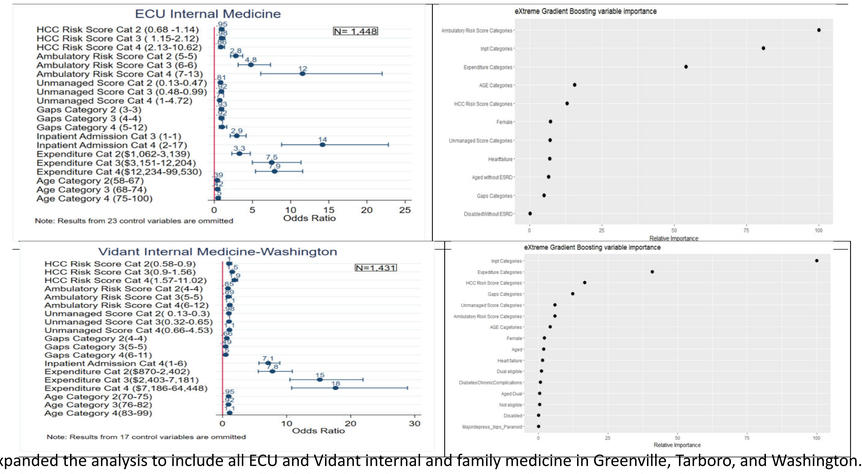
Improve ED utilization prediction by assessing various risk scores to identify the more and consistent predictive risk score by November 1, 2018.

PROJECT DESIGN/STRATEGY

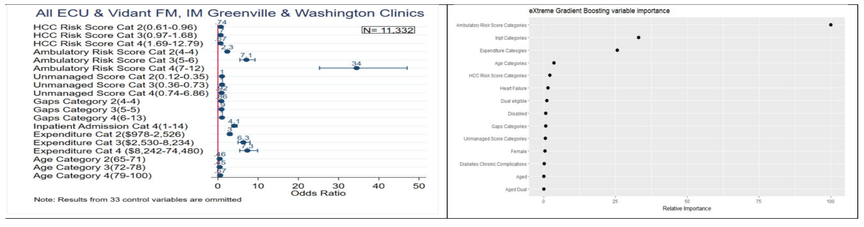
First, we accessed ECU Internal Medicine clinic data from Care Evolution which included key variables such as age, gender, Medicare status (aged, aged dual eligible, disabled and ESRD), number of inpatient admissions, 12-month expenditure among other variables.
The variable of interest was the number of ED visits over a 12-month period, while risk scores included CMS-Hierarchical Condition Category (HCC) risk score and ambulatory risk score. Other risk score measures include unmanaged score and number of gaps in care. HCC risk score is used to adjust payment to providers who care for Medicare patients while ambulatory risk score is an internal composite measure intended to reflect the severity and illness burden. Unmanaged score and number of gaps score are count measures of patient issues that have not been addressed according to guidelines
Next, we created dummy variables containing quantile categories of the variables of interest including the dependent variable, number of ED visits.
We tested different regression models to find a good fit and ordered logistic regression models were found to be a better fit than other models tested including ordinary linear regression.
We used the categorization to run ordered logistic regression while controlling for intergroup correlation at the Zip Code level.
Also, we utilized a machine learning open source package, healthcare.ai to estimate several predictors that are potentially important in predicting the ED utilization.
The analyses were performed using Stata 15[3] and R version 3.4.4[4] using healthcare.ai package[5].

CHANGES MADE (PDSA CYCLES)

We conducted a regression starting with one clinic, ECU Internal Medicine clinic (n= 1,448). After identifying the predictive risk scores and other variables we repeated the same regression with data from Vidant Washington Internal Medicine clinic (n= 1,431)
The idea was to see if the same the ED utilization predictive risk scores and variables were also statistically significant across practices. We noted that in this case, they were not. We, therefore, combined both clinics’ data and reran the same regressions and took note of the relative important variables.



We finally expanded the analysis to include all ECU and Vidant internal and family medicine in Greenville, Tarboro, and Washington. ECU practices included in the analyses are in Greenville while Vidant Clinics are in Greenville, Tarboro, and Washington (n= 11,322). To ensure consistency and monitor for possible clinic outliers, we first conducted categorization on each clinic, noting patient demographics and utilization variation across practices. 221 patient records with extreme values (more than three standard deviations from the average in healthcare expenditure) were excluded from the analyses



RESULTS/OUTCOMES

The combined data of ECU and Vidant family and internal medicine clinics in Greenville, Tarboro, and Washington indicate that of the 11,332 patients included in the analysis, 6,566(57.99%) were female, and 4,756(42.01%) were male. The average HCC Risk score was 1.39(SD: 1.35), Ambulatory Risk Score averaged 4.76(SD: 1.83), Unmanaged Score averaged 0.54(SD: 0.65), while some gaps averaged 3.25(SD: 1.58). The ED visits ranged from 0 to 129visits with a 1.15(SD: 2.59) average number of visits.
The regression results from the initial ECU IM clinic, see above, show that the ambulatory risk score categories were statistically significant in predicting ED utilization. For example, a patient with an ambulatory risk score ranging from 4-13 had a 12(1,100%) odds of using ED more than a patient with a 0-5 ambulatory risk score. This is consistent with findings from the secondary analysis using healthcare.ai machine learning package. The results indicate that ambulatory risk score categories, followed by inpatient admission, and 12-month expenditure are the top three factors regarding relative importance in predicting ED utilization.

Data analysis from the Vidant IM -Washington, indicates that ambulatory risk score, in this clinic, is not a statistically significant predictor of ED utilization. Instead, HCC risk score is statistically significant in predicting ED utilization. This is confirmed with the results from the healthcare.ai analysis, which indicate that inpatient admission, healthcare expenditure, followed by HCC risk are the top three leading factors in predicting ED utilization. The results from the analysis using pooled data from all ECU and Vidant family and internal medicine clinics in the Greenville and surrounding areas shows, the ambulatory risk score is statistically significant in predicting ED utilization. For example, a patient with 7-12 ambulatory risk score has 34 (or 3,300 %) odds of using ED as compared to a patient with a score of less than 4. Also, relative variable importance analysis confirms ambulatory risk score is the leading factor in relative importance in predicting ED utilization followed by inpatient admission and healthcare expenditure categories. Across the 11 clinics, the results indicate that ambulatory risk score in conjunction with inpatient admission, and healthcare expenditure are consistently good predictors of ED utilization, except for the Vidant IM Washington clinic.

References:
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LESSONS LEARNED

The ambulatory risk score performs better in predicting ED utilization along with prior inpatient admission and healthcare expenditure. This probably reflects the scoring mechanism that is designed to show patients who are likely to need more attention due to the burden of illness.
Overall, patients with an ambulatory risk score of 7 or more, more than two inpatient admission in the last year and whose overall expenditure exceeded $ 7, 000 in the previous year have higher odds of utilizing ED.
HCC Risk score, except for one clinic, seems to be a better indicator for inpatient admission and not ED utilization.

The finding that the HCC risk score is not a good predictor of ED utilization add to the evidence that the risk score has some flaws including differences in scoring which penalizes more rural providers[6]. Also, the risk score was designed to adjust patients, not as a predictor of utilization.
There is an opportunity to improve the risk score even further given the current scoring is not statistically weighted to reflect the unique burden of specific illnesses. For example, the score takes in counts of illnesses, medication, and other statuses as equal in magnitude. Instead, a better way might be to use regression results to weight each component of the score.
The results indicate that it is possible to use clinic specific data to predict ED utilization and possibly use the prediction to deploy finite resources in a targeted intervention.

NEXT STEPS

This projects’ first step was to assess the risk scoring that exists systematically. The findings show the internally built ambulatory risk score is by far the more predictive of ED utilization. The score coupled with the inpatient admission and healthcare expenditure from the previous one year might be a quick and easy way to gauge which patients need intervention.

The next step will be to refine the ambulatory risk score, so it can reflect the findings and hopefully be better predictive of ED utilization than it is. Finally, the prediction will help optimize care by targeting interventions and finite resources on patients who need the help and might benefit the most.

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Jason Mose, Ph.D., MBA, MS, CHFP
Department of Health Services & Information Management
Greenville, North Carolina 27858
252-744-6170
mosej17@ecu.edu