Epic data Results

C Ryan King, MD PhD Lavanya Pedamallu, PharmD MS

June 22, 2022

0.1 Methods

Data from 2018-08-31 to 2020-12-30 were queried from the Epic electronic health record. Patients were matched to hospital admission, discharge, billing and mortality data. Records were filtered to include those with preoperative clinic visits with AD8 or SBT measured, surgery within 90 days of that clinic visit, and matching billing and discharge records. A subset of surgical procedures were included into the analytical dataset, procedure codes for which are in the appendix. This restriction was intended to reduce confounding due to surgical complexity. That is, we suspect that patients with impaired cognition may be selectively referred to medical vs surgical management of their conditions, and that patients with impaired cogition will be referred for surgeries with less physiologic stress. These procedures were felt to be ones with little variation in overall surgical complexity which would contribute to this selection bias.

Because our principal outcomes (readmission, discharge to home) and inclusion critereon (procedure codes) are generated at the hospitalization level, we treat that as the unit of analysis. Readmission in 30 days and length of stay was only considered for patients with discharge to home.

Association between preoperative cognitive impairment (defined as a Short Blessed Test >= 2 or a AD8 >= 5) was assesed using logistic regression models adjusting for surgical procedure type, sex, age using a 5 degree of freedom cublic spline, indicator variables for history of diabetes, chronic kidney disease, chronic obstructive pulmonary disease, CVA(TIA), cancer status, and congestive heart failure.
Each hospitalization can have procedures qualifying in multiple categories; we created indicator variables for each procedure category and assumed additivity for hospitalizations with more than one type of procedure. Logisitic regression models with the same adjustment startegy were considered for readmission and near-term death. A log-link generalized linear model (quasipoisson) with the same set of adjusting variables was used for length of stay.

Heterogeneity of association between abnormal cognition and outcomes was assessed using an expanded model with an interaction term and a score-test. To compare the predictive value of AD8 or SBT, we used two approaches. First, we used a k-fold cross-validation method (K=100) fitting logistic regression models predicting each outcome using AD8 or SBT, then assessing the accuracy by area under the receiver operating characteristic curve in the hold-out sample. Each 100 pairs of accuracy metrics are then compared by a paired t-test. Second, we used the Vuong test for non-nested models https://doi.org/10.2307/1912557 implemented by the “nonnest2” package version 0.5-5.

All analysis was conducted using R 4.1.2. A repository containing the analysis code is available at https://github.com/cryanking/cognition_discharge

0.2 Results

The filtered dataset included 8315 distinct patients with 8950 hospitalizations. Characteristics of the cohort and overall outcome rates are given in Table 1. AD8 was abnormal (>=2) in 3.7 percent of included patients; SBT was abnormal (>=5) in 17.8 percent of included patients.

Table 1: Descriptive statistics stratified by Cognition status. P-values for quantitative variables by Mann-Whitney U, factor variables by Fisher's exact test. CAD = Coronary artery disease, CHF = Congestive heart failure, Diabetes = Diabetes mellitus, COPD = Chronic obstructive pulmonary diseae, CKD = chronic kidney disease, CVA (TIA) = history of stroke or transient ischemic attack, dc_home = discharge to home, readmit = readmission within 30 days, los = postoperative hospital length of stay computed from first qualifying procedure, death = death in hospital or within 30 days of surgery

	normal	impaired cognition	p
n	7128	1822	
Sex = 2 (%)	3530 (49.5)	993 (54.5)	<0.001
RACE (%)			NA
Other	48 (0.7)	17 (0.9)	
White	6392 (89.7)	1436 (78.8)	
Black	637 (8.9)	357 (19.6)	
Asian	45 (0.6)	11 (0.6)	
other_pacific_islands	6 (0.1)	1 (0.1)	
CAD (%)	1856 (26.0)	639 (35.1)	<0.001
CHF (%)	830 (11.6)	379 (20.8)	<0.001
Diabetes (%)	2115 (29.7)	684 (37.5)	<0.001
COPD (%)	1189 (16.7)	423 (23.2)	<0.001
CKD (%)	1646 (23.1)	603 (33.1)	<0.001
CVA(TIA) (%)	447 (6.3)	276 (15.1)	<0.001
cancerStatus (%)			NA
Skin Cancer	4646 (65.2)	1224 (67.2)	
in remission/radiation/chemo	901 (12.6)	193 (10.6)	
Current Cancer	1388 (19.5)	339 (18.6)	
Metastatic Cancer	193 (2.7)	66 (3.6)	
age (median [IQR])	72 [68, 76]	74 [69, 79]	<0.001
dc_home (%)	1139 (16.0)	662 (36.3)	<0.001
readmit (%)	318 (4.5)	90 (4.9)	0.379
death (%)	164 (2.3)	109 (6.0)	<0.001
ICU (%)	1228 (17.2)	426 (23.4)	<0.001
los (median [IQR])	4 [2, 9]	5 [2, 11]	<0.001

The frequency of each type of surgery is displayed in Table 3. The frequencies do not add up to the number of hospitalizations because of multiple procedures per hospitalization.

We found that impaired cognition was significantly associated with discharge to home (odds ratio 2.48, 95% CI 2.19 to 2.81, p = <0.001). For readmission in 30 days, impaired cognition was not a significant predictor (odds ratio 0.90, 95% CI 0.65 to 1.25, p = 0.168). For near-term death, impaired cognition was a significant predictor (odds ratio 1.93, 95% CI 1.48 to 2.51, p = <0.001). Impaired cognition was not a significant predictor of length of stay (duration ratio 1.04, 95% CI 0.91 to 1.06, p = 0.611).

We found no convincing evidence of heterogeneity by type of surgery, although power for this question is limited by small sample sizes in some surgery types. A score test comparing models with and without interaction terms yielded a p-value of 0.370 A forest plot is presented in Figure 1.

Glm was claculated for the exploratory outcomes such as Pneumonia, AF, Post AKI status, CVA, Post trop high, Respiratory failure Table 3.

We found that Non-nested likelihood ration test was not significant with the p values ‘ r print(analysis_pipe_vu_output$p_LF

Table 2: Number of Procedures by Type

Surgery Type	N
lap hiatal hernia	56
cholecystectomy	81
cystectomy	92
nephrectomy	156
gastric	168
pancreatic	174
prostatectomy	294
lumbar fusion	406
total hip	417
total knee	480
hysterectomy	491
total shoulder	491
intestinal	662

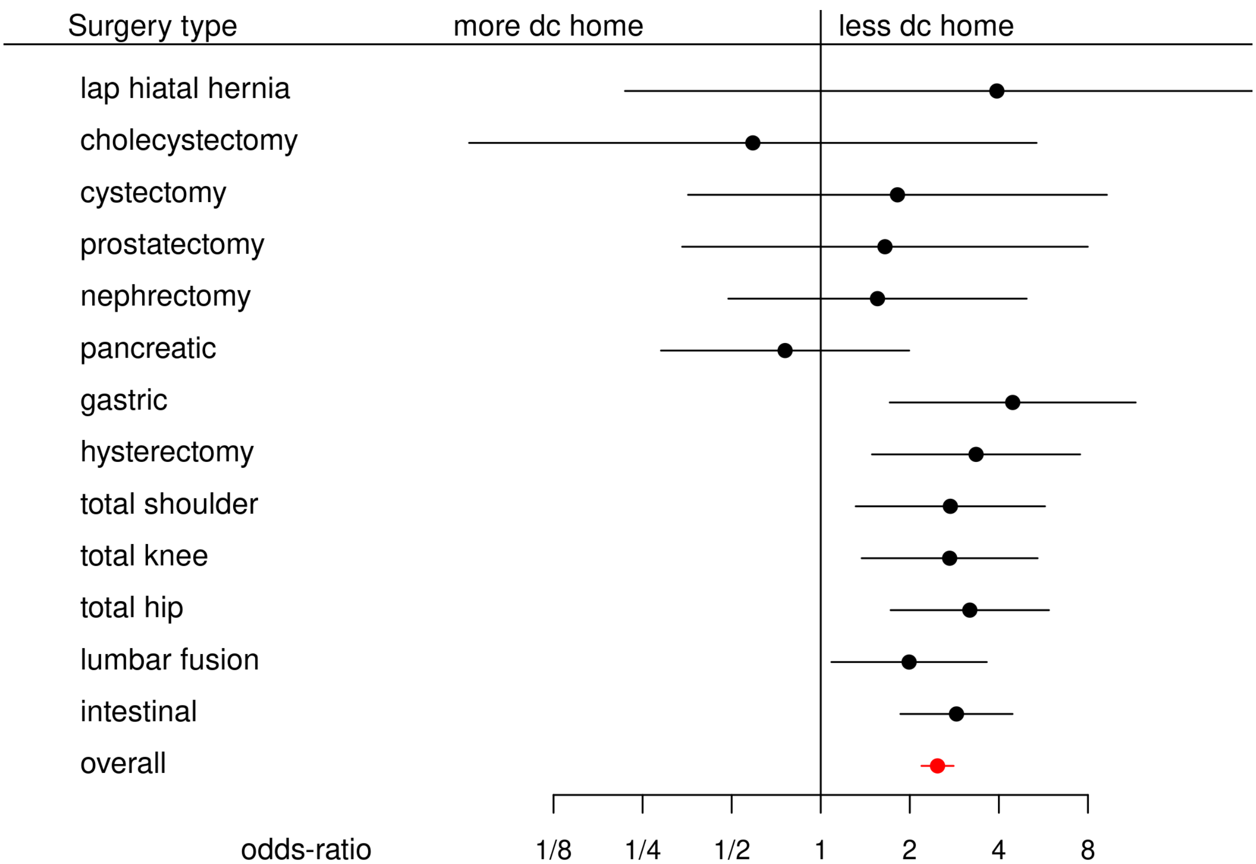

Figure 1: Odd-ratio for discharge to home with impaired cogition by surgery type. Dot = point estimate, lines 95 % confidence intervals

Table 3: GLM for exploratory outcomes

exploratory_outcomes	Std. Error	Pr(>|z|)	2.5 %	97.5 %
CVA	0.31	0.718	-0.502	0.728
PNA	0.32	0.495	-0.410	0.848
AF	0.08	0.711	-0.196	0.134
post_aki_status	0.11	0.000	0.188	0.634
post_trop_high	0.15	0.006	0.117	0.689
resp_failure	0.10	0.000	0.249	0.645

Model 1 Class: glm Call: glm(formula = myform, family = binomial(), data = .)

Model 2 Class: glm Call: glm(formula = myform, family = binomial(), data = .)

Variance test H0: Model 1 and Model 2 are indistinguishable H1: Model 1 and Model 2 are distinguishable w2 = 0.009, p = 2.82e-09

Non-nested likelihood ratio test H0: Model fits are equal for the focal population H1A: Model 1 fits better than Model 2 z = 1.222, p = 0.111 H1B: Model 2 fits better than Model 1 z = 1.222, p = 0.8892

`Welch Two Sample t-test`

data: na.omit(r1) and na.omit(r2) t = 1.455, df = 192.7, p-value = 0.1473 alternative hypothesis: true difference in means is not equal to 0 95 percent confidence interval: -0.005692823 0.037715783 sample estimates: mean of x mean of y 0.7356375 0.7196260