Hospital Readmissions EDA & Modeling

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GRMC

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AGENDA

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1. PROBLEM STATEMENT
2. DATASETS
3. DATA EXPLORATION
4. FEATURE SELECTION
5. MODEL DEPLOYMENT AND EVALUATION
6. CONCLUSION

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PROBLEM STATEMENT

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COST OF ADMISSIONS

The cost of readmissions within 30 days is large for patient and hospital, ranging from $10,900 to $15,200

TOP CAUSES OF HOSPITAL READMISSION

1. Septicemia
2. Heart Failure
3. Diabetes
4. COPD

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*Didn’t encode factor features due to the large amount of existing columns

DATASETS

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FILE NAME	ROWS	COLUMNS	DESCRIPTION
diabetesHospitalInfoTrain.csv	7500	16	information gathered at the hospital i.e.. number of lab procedures and diagnosis descriptions
diabetesHospitalInfoTest.csv	2500	16	
diabetesMedsTrain.csv	7500	23	patients medicine information i.e.. patient is taking a specific drug like Metformin
diabetesMedsTest.csv	2500	23	
diabetesPatientTrain.csv	7500	7	patients' demographic and insurance information i.e.. race, gender, age, weight
diabetesPatientTest.csv	2500	7	

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DATA EXPLORATION

FILE NAME	ROWS	COLUMNS	DESCRIPTION
patientsComined.csv	10,000	45	All data from the previous datasets

* Creating train/test column to distinguish observations

DATA PREPARATION

* Removed columns with only one value or +95% of observations concentrated in 1 value (Low cardinality)
* Discarded features diagnosis 2 and 3 since we don't know if they were readmitted before 30 days after the first diagnosis
* Discarded Discharge Disp. values related to patients' death and Hospice
* Divided columns into factor and numeric
* Checked for outliers

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DATA EXPLORATION

MISSING VALUES IMPUTATION

NUMERIC

No N.A. values found in the dataset

FACTOR

Vtreat as an algorithm for feature manipulation due to the low quantity of features with missing values

FEATURE SELECTION

* Splited training data into treatment plan data (10%), training data (72%) and validation data (18%)

* Applied treatment plan to perform feature engineering

* Applied Boruta feature selection algorithm (random forest model & shadow feature set) to identify important features.

*Discarded redundant and duplicated features

DATA EXPLORATION

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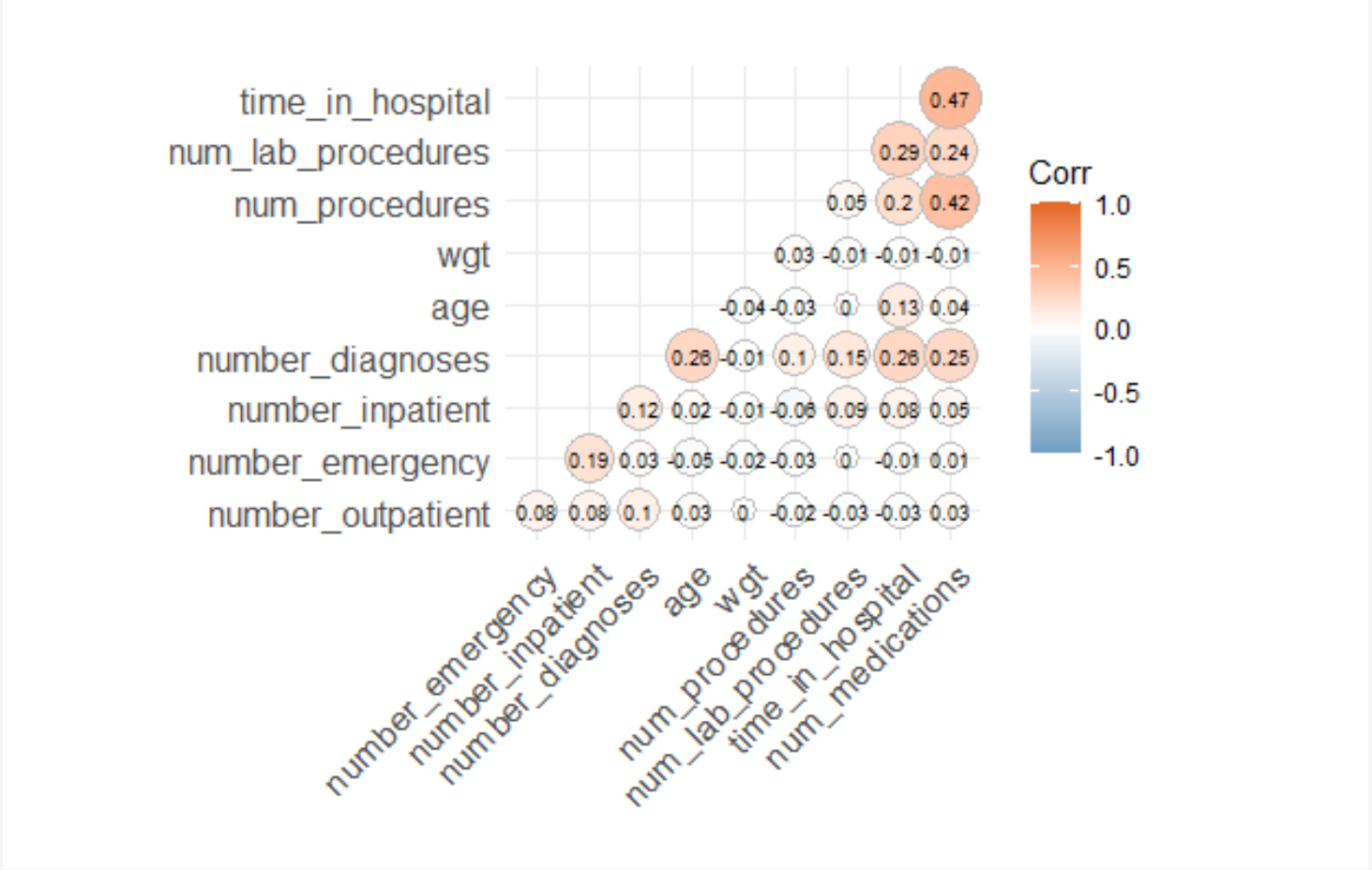
CORRELATION MATRIX



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FEATURE SELECTION

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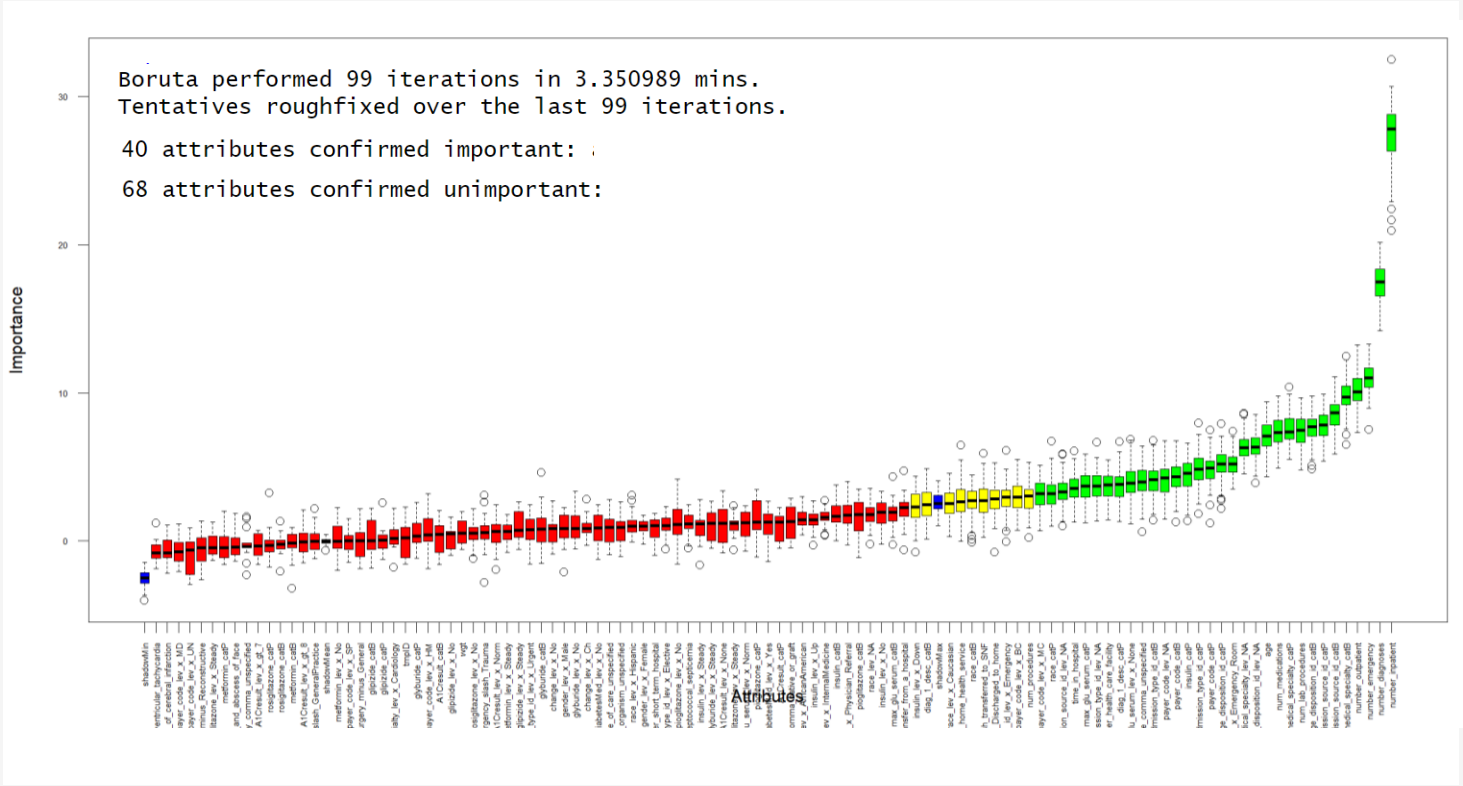
BOROUTA FEATURE IMPORTANCE



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MODEL DEPLOYMENT AND EVALUATION

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MODEL LIST

- LOGISTIC REGRESION
- DECISION TREE
- NAIBE BAYES
- RANDOM FOREST
- NEURAL NETWORKS
- GRADIENT BOOSTING

* Models trained and evaluated with training and validation data sets.
* Performed backward stepwise regression to eliminate noise in LR model.

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MODEL DEPLOYMENT AND EVALUATION

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ACCURACY COMPARISON

```
Models: LR, DT, RF, NB, NN, GB
Number of resamples: 10

Accuracy
        Min.   1st Qu.    Median      Mean   3rd Qu.      Max. NA's
LR 0.6337761 0.6359758 0.6495696 0.6482410 0.6559080 0.6736243    0
DT 0.5958254 0.6212663 0.6324774 0.6298212 0.6365800 0.6565465    0
RF 0.6349810 0.6399431 0.6454373 0.6467222 0.6527514 0.6653992    0
NB 0.5920304 0.6200190 0.6283270 0.6296322 0.6440421 0.6546490    0
NN 0.6242884 0.6364510 0.6444867 0.6482475 0.6589112 0.6793169    0
GB 0.6280835 0.6389546 0.6425856 0.6503333 0.6630237 0.6787072    0

Kappa
        Min.   1st Qu.    Median      Mean   3rd Qu.      Max. NA's
LR 0.1968504 0.2109614 0.2386247 0.2343025 0.2523625 0.2847358    0
DT 0.0797967 0.1563945 0.1845117 0.1711788 0.2017906 0.2251322    0
RF 0.1793672 0.1975395 0.2083110 0.2077823 0.2174913 0.2488763    0
NB 0.1307967 0.1907341 0.2157001 0.2132613 0.2391249 0.2740497    0
NN 0.1849879 0.2158363 0.2376605 0.2441968 0.2731321 0.3148104    0
GB 0.1873171 0.2206987 0.2270323 0.2420725 0.2702509 0.3042001    0
```

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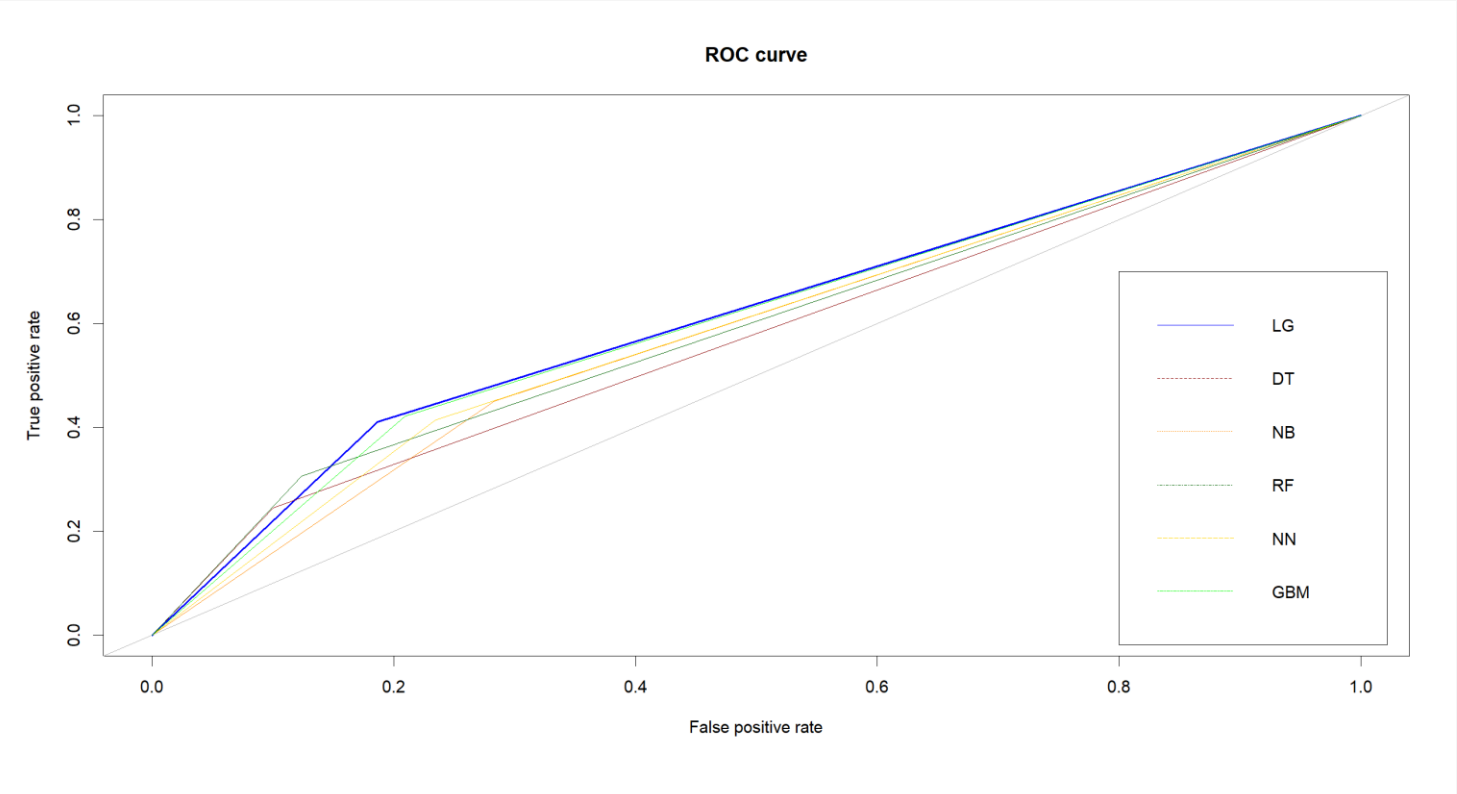
ROC CURVE



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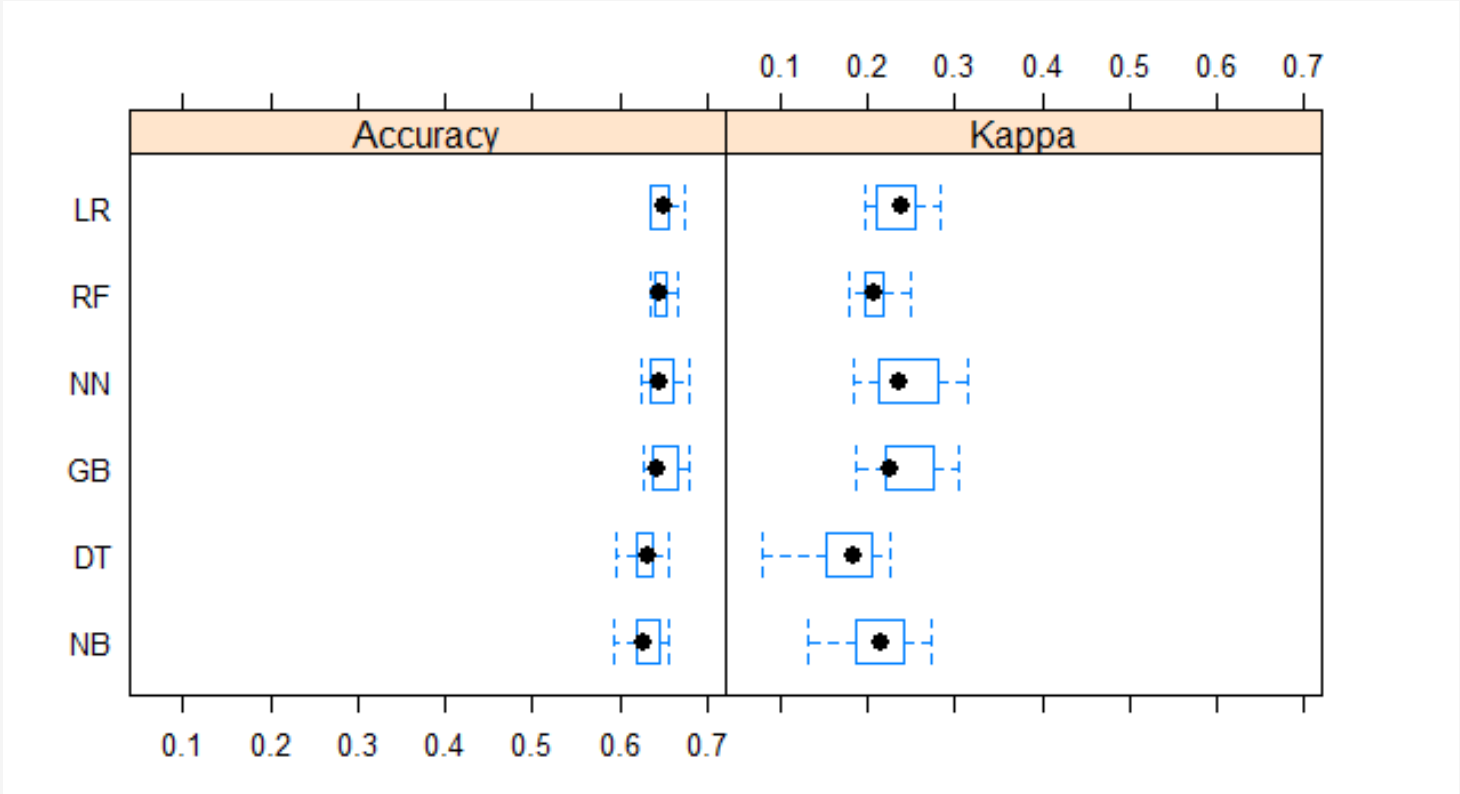
ROC CURVE



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CONFUSION MATRIX

GRADIENT BOOSTING

Prediction	Reference FALSE	TRUE
FALSE	631	300
TRUE	167	219

Sensitivity	0.7907
Specificity	0.4220
Pos Pred Value	0.6778
Neg Pred Value	0.5674
Prevalence	0.6059
Detection Rate	0.4791
Detection Prevalence	0.7069
Balanced Accuracy	0.6063

RANDOM FOREST

Prediction	Reference FALSE	TRUE
FALSE	699	360
TRUE	99	159

Sensitivity	0.8759
Specificity	0.3064
Pos Pred Value	0.6601
Neg Pred Value	0.6163
Prevalence	0.6059
Detection Rate	0.5308
Detection Prevalence	0.8041
Balanced Accuracy	0.5911

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CONFUSION MATRIX

NEURAL NETWORKS

```
          Reference
Prediction FALSE TRUE
     FALSE   611  304
     TRUE    187  215

          Sensitivity : 0.7657
          Specificity : 0.4143
       Pos Pred Value : 0.6678
       Neg Pred Value : 0.5348
           Prevalence : 0.6059
       Detection Rate : 0.4639
 Detection Prevalence : 0.6948
    Balanced Accuracy : 0.5900
```

LOGISTIC REGRESSION

```
          Reference
Prediction  no yes
       no  745 416
       yes  53 103

          Sensitivity : 0.9336
          Specificity : 0.1985
       Pos Pred Value : 0.6417
       Neg Pred Value : 0.6603
           Prevalence : 0.6059
       Detection Rate : 0.5657
 Detection Prevalence : 0.8815
    Balanced Accuracy : 0.5660
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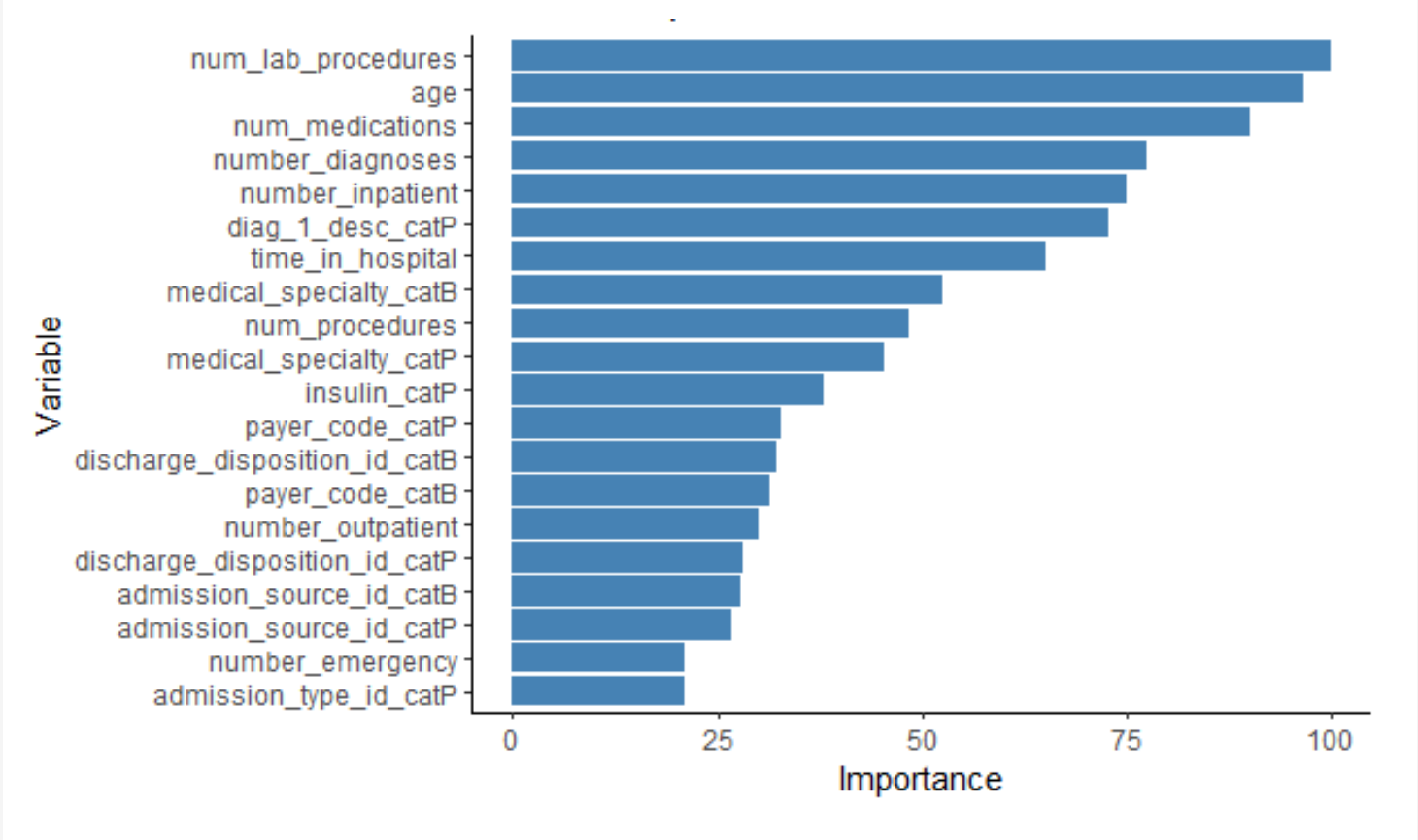
RANDOM FOREST FEATURE IMPORTANCE



* Top 100 patients with highest probability of readmission with probabilities ranging 66.4% – 87.2%

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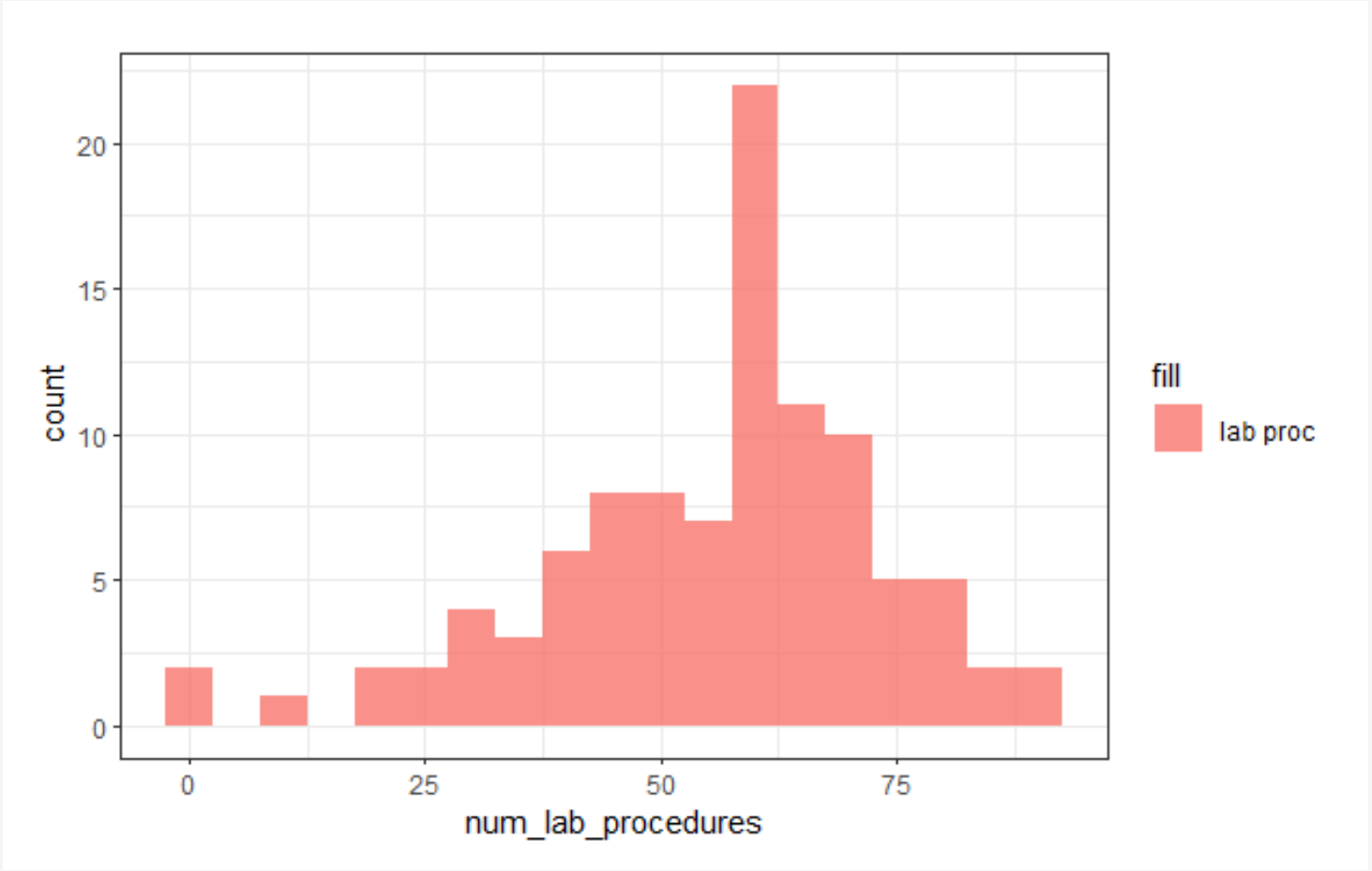
NUMBER OF LAB PROCEDURES



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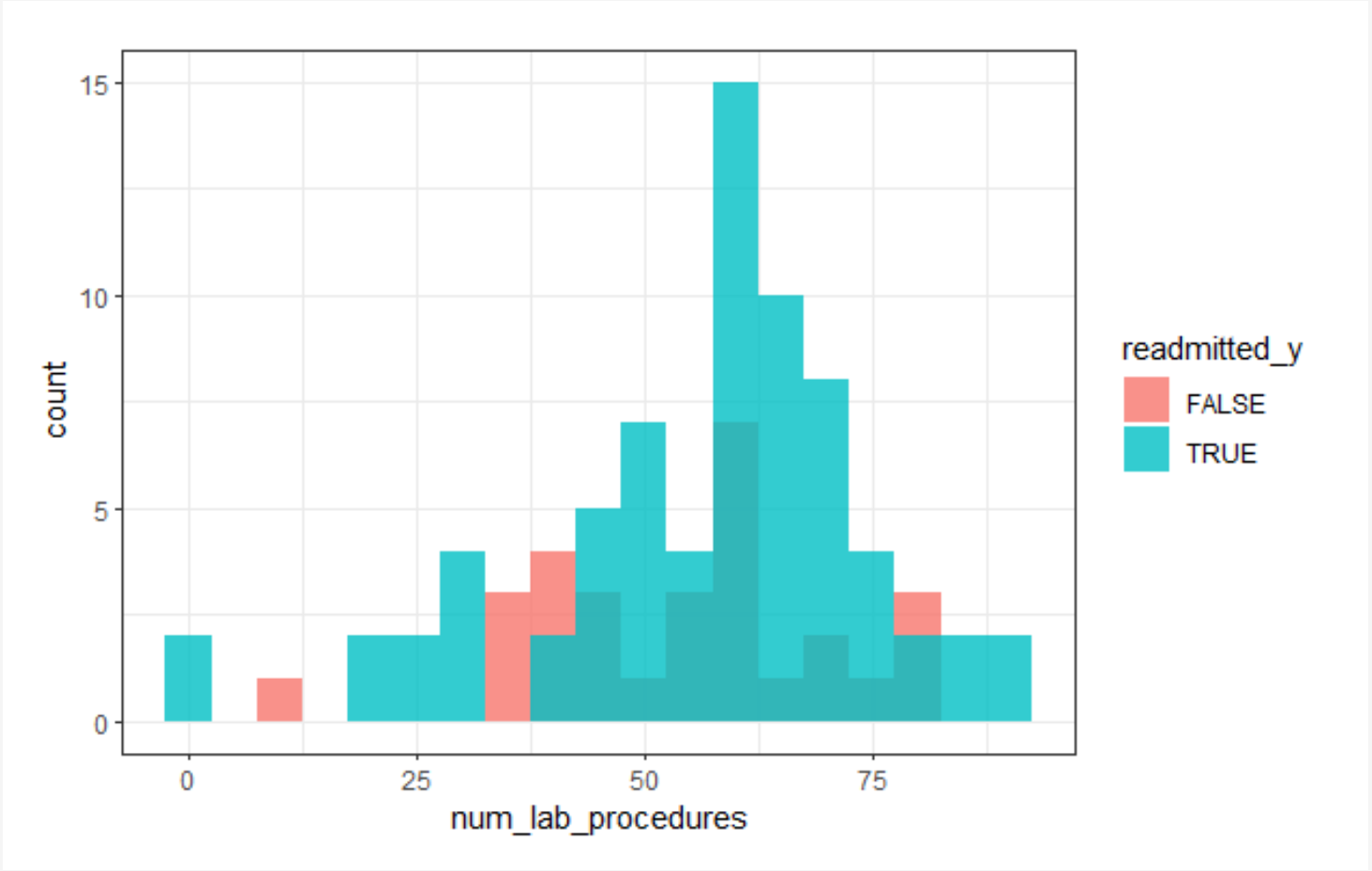
NUMBER OF LAB PROCEDURES



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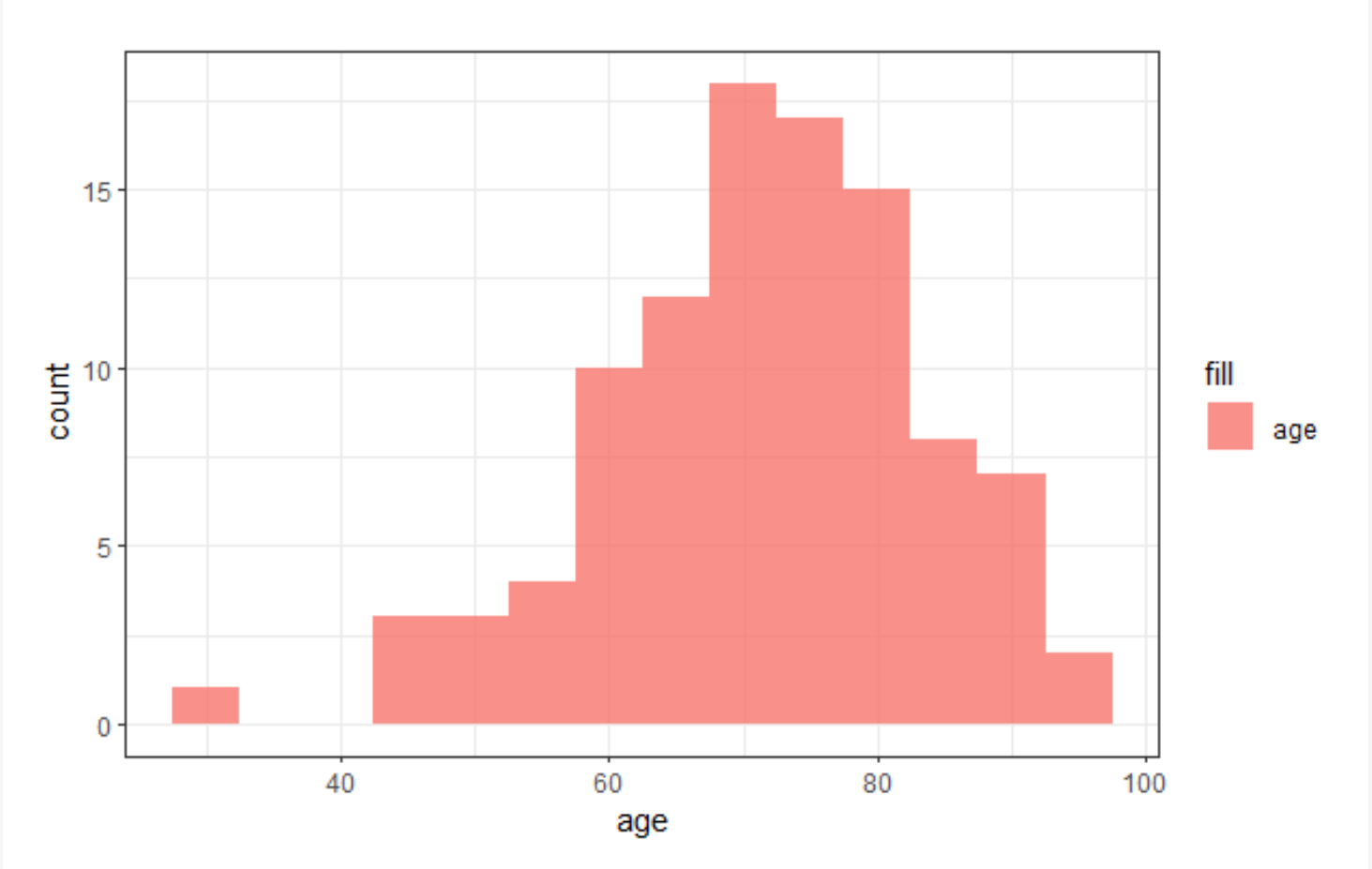
AGE OF PATIENTS



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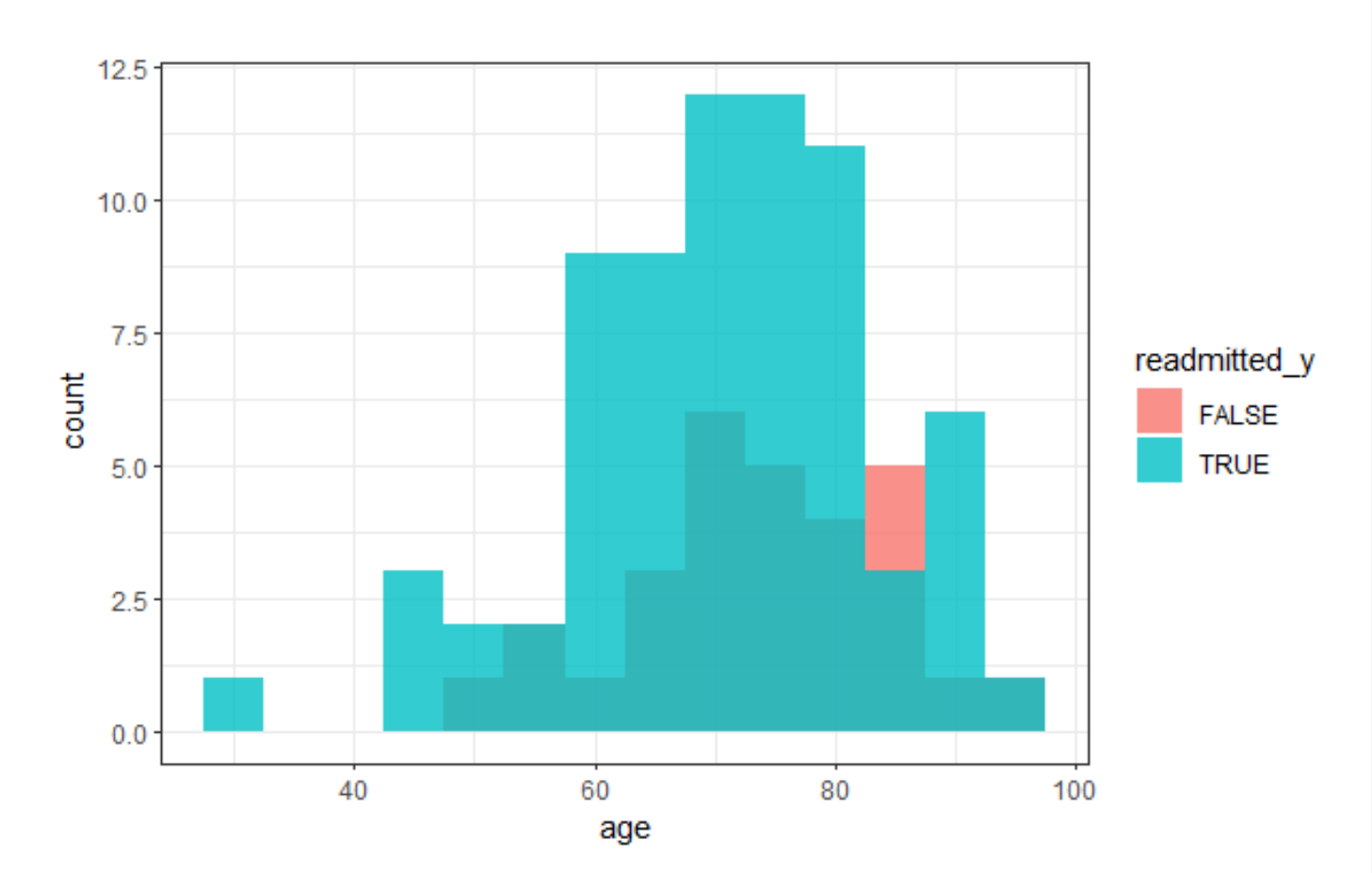
AGE OF PATIENTS



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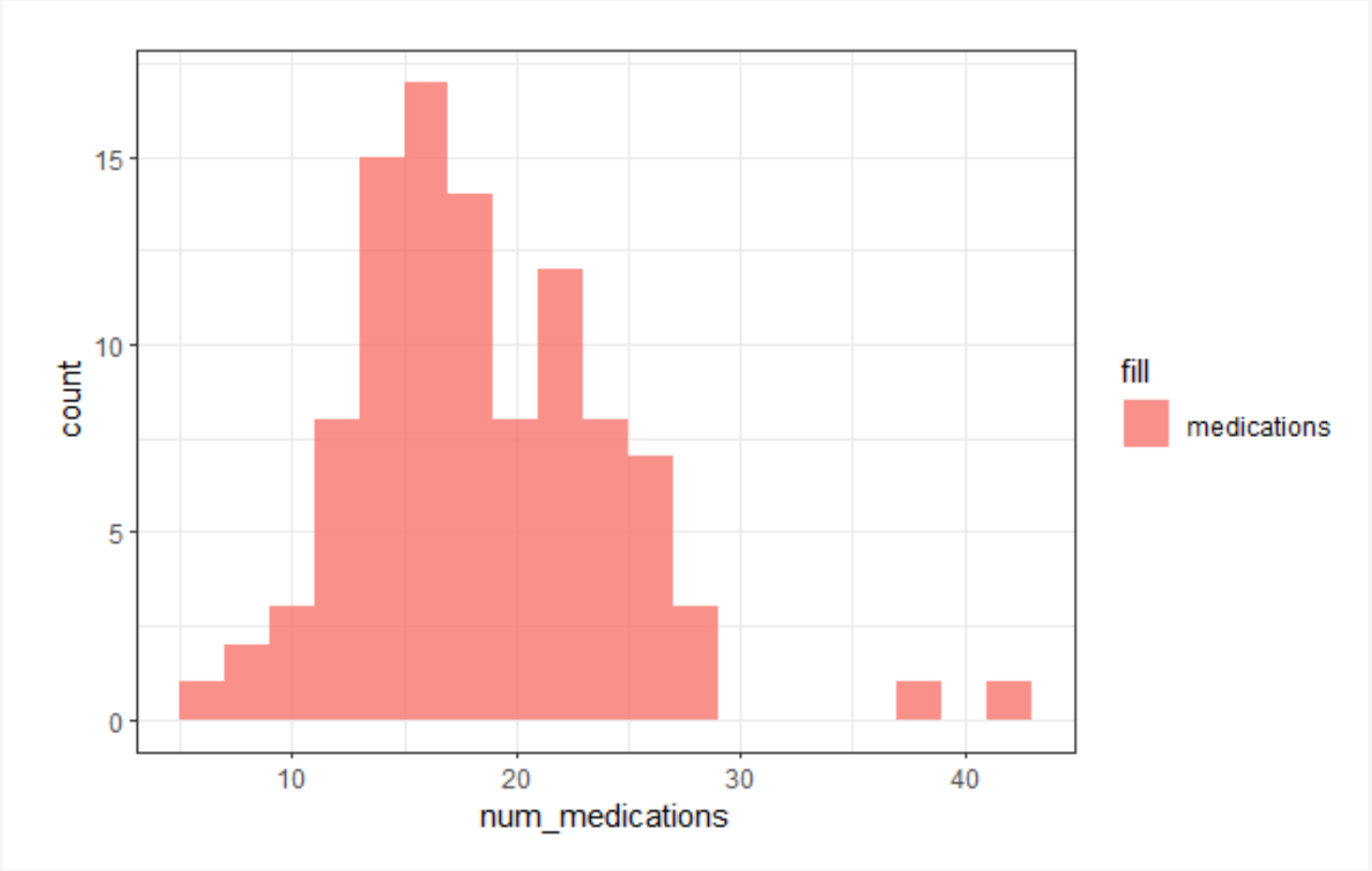
NUMBER OF MEDICATIONS



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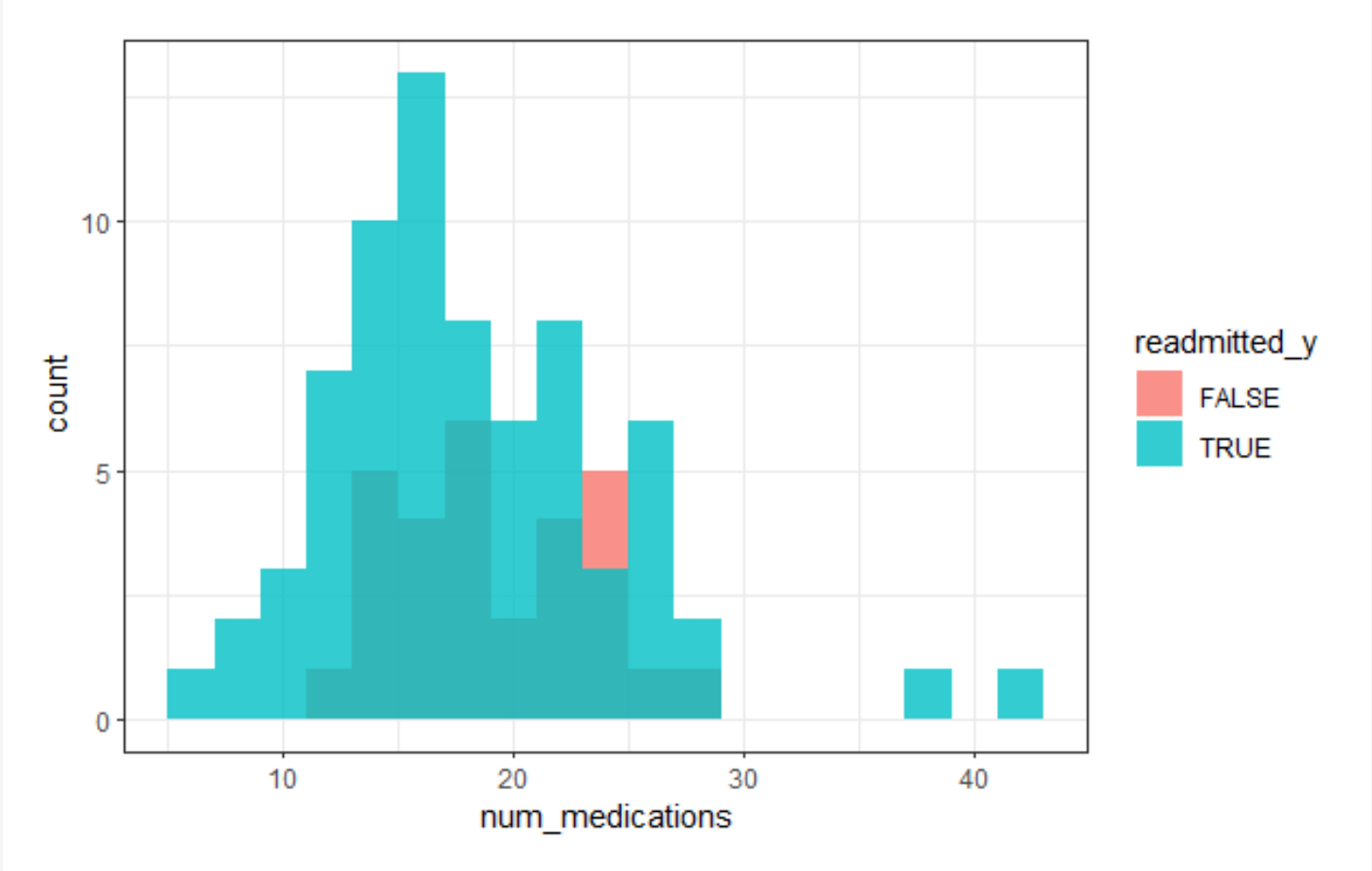
NUMBER OF MEDICATIONS



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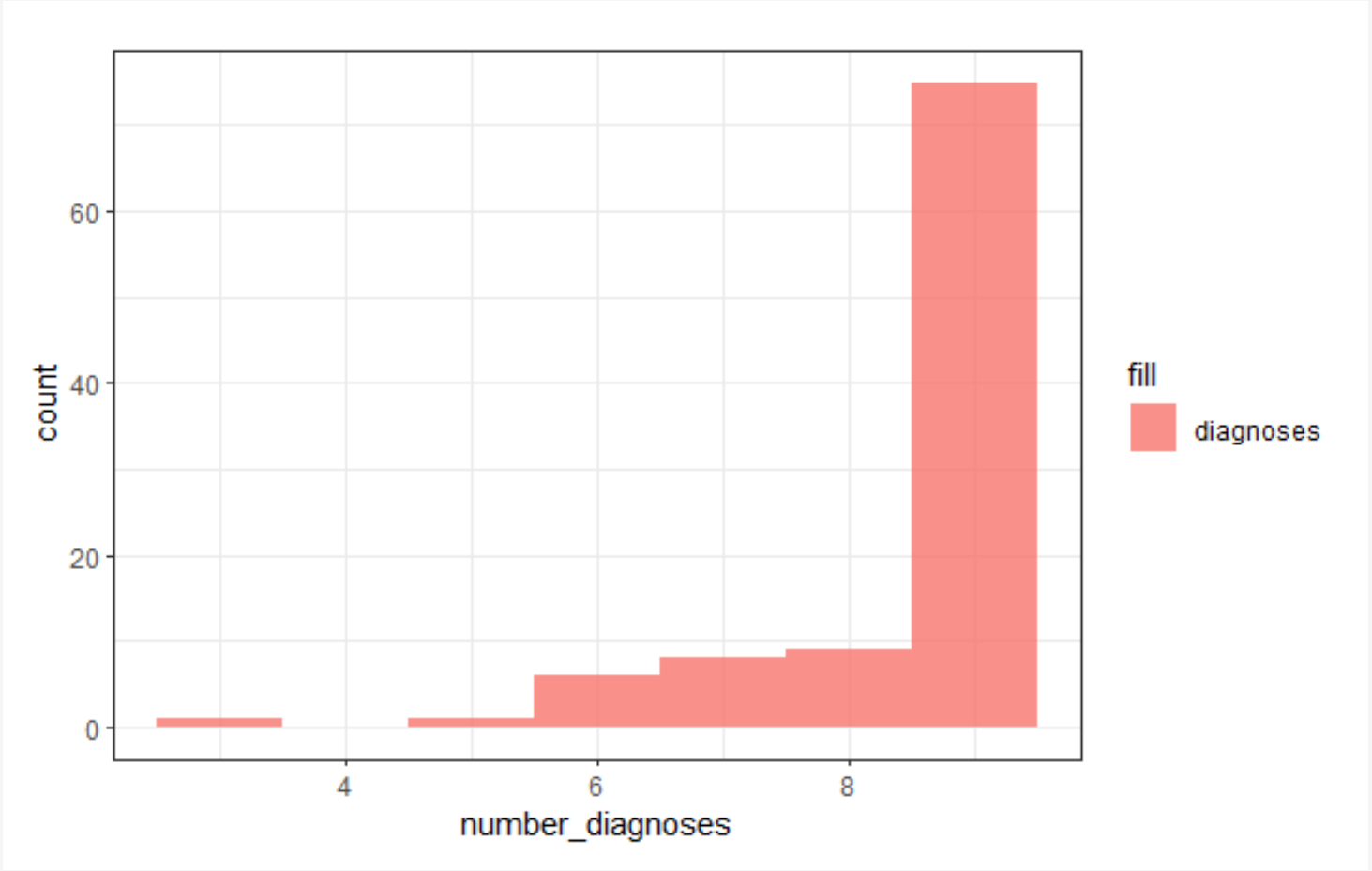
NUMBER OF DIAGNOSES



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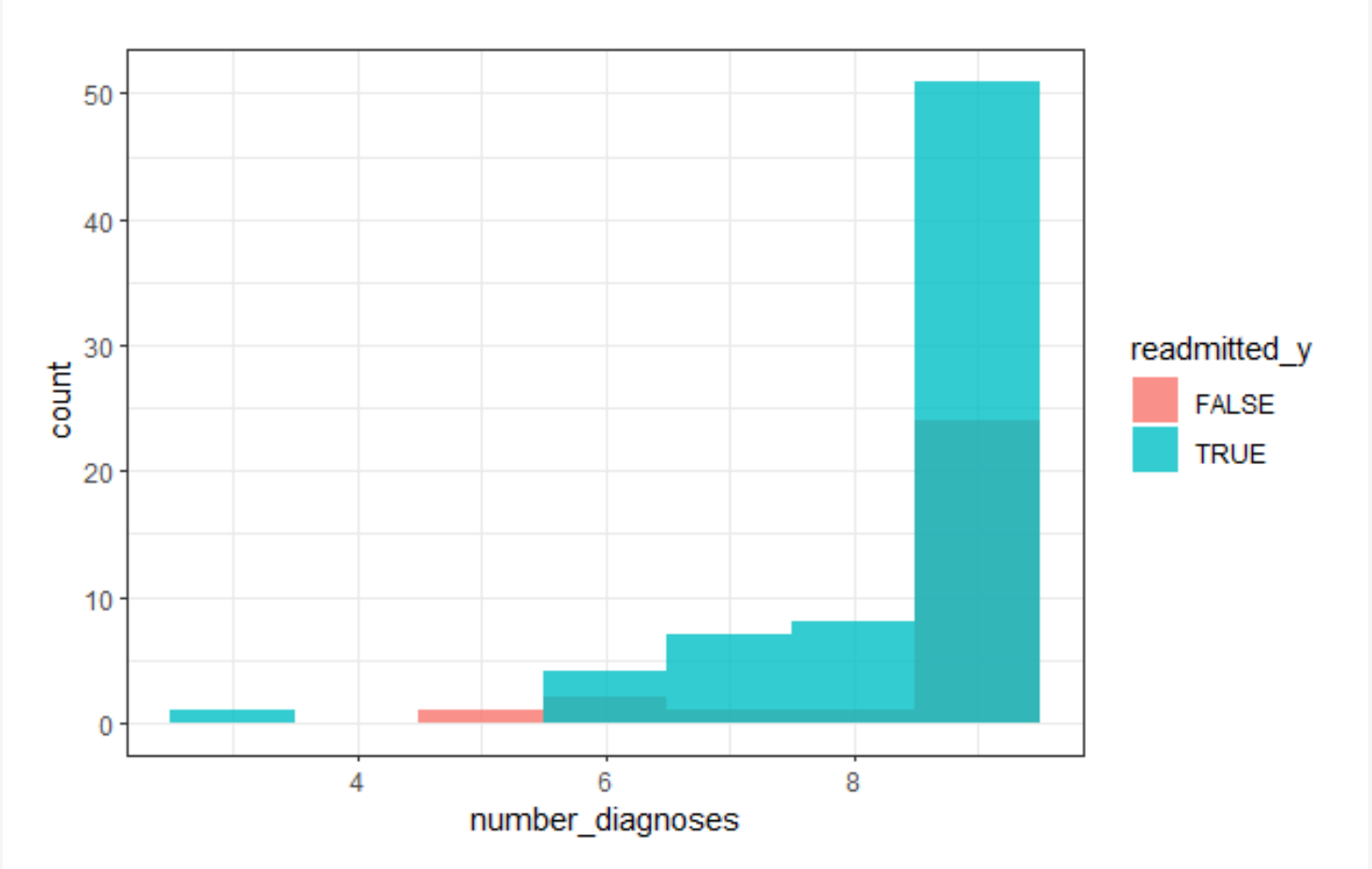

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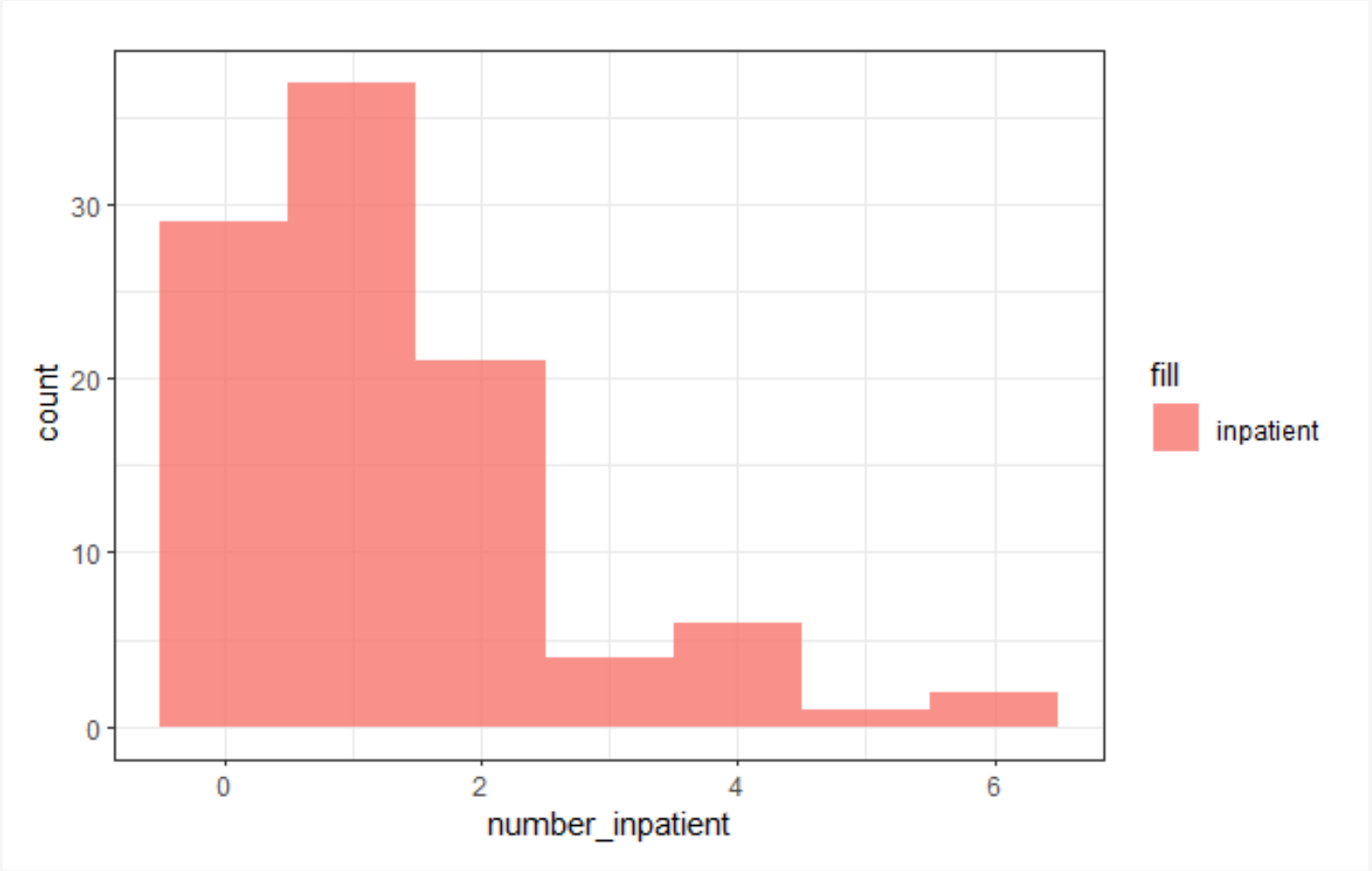
NUMBER OF INPATIENT



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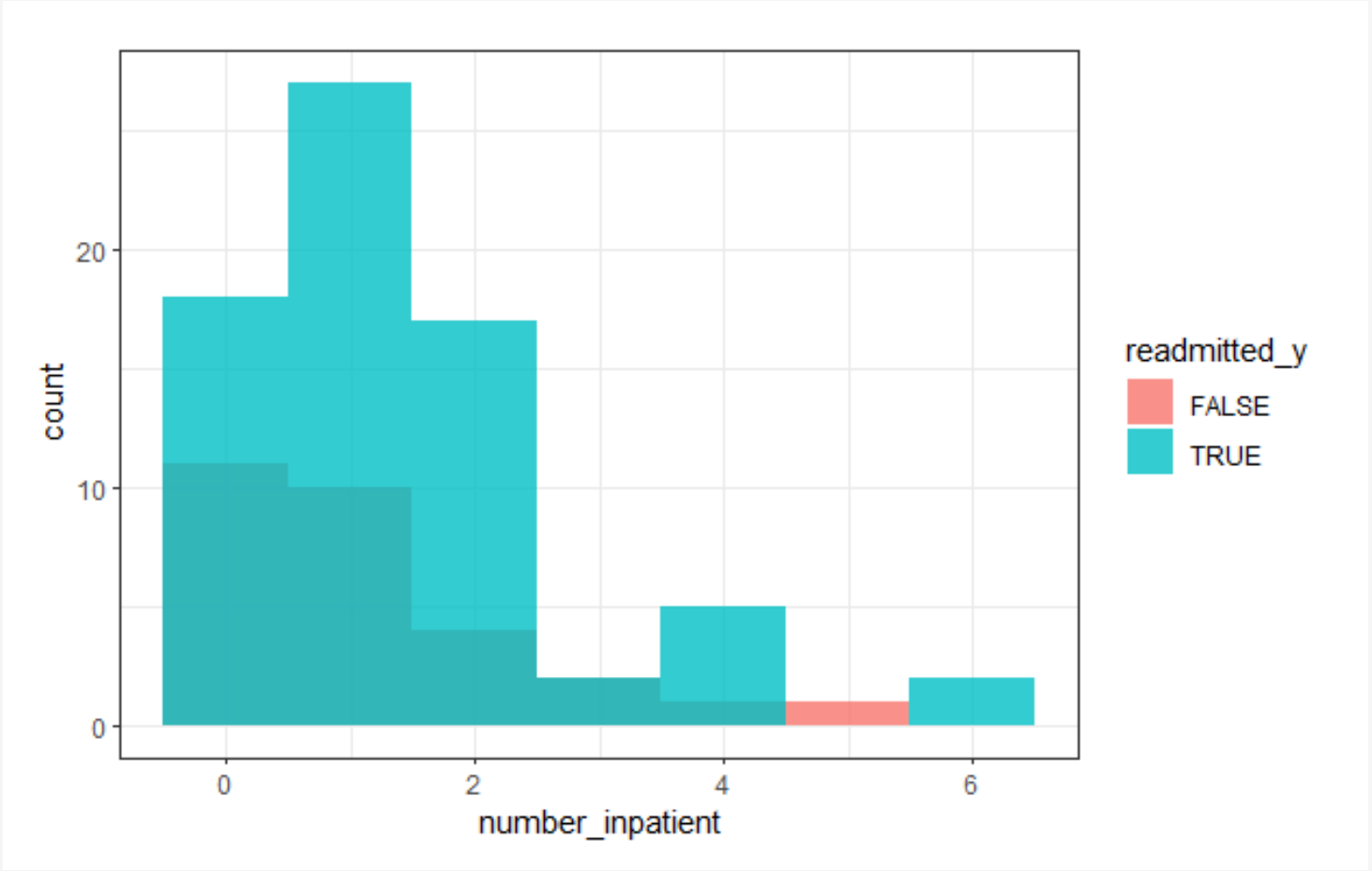
NUMBER OF INPATIENT



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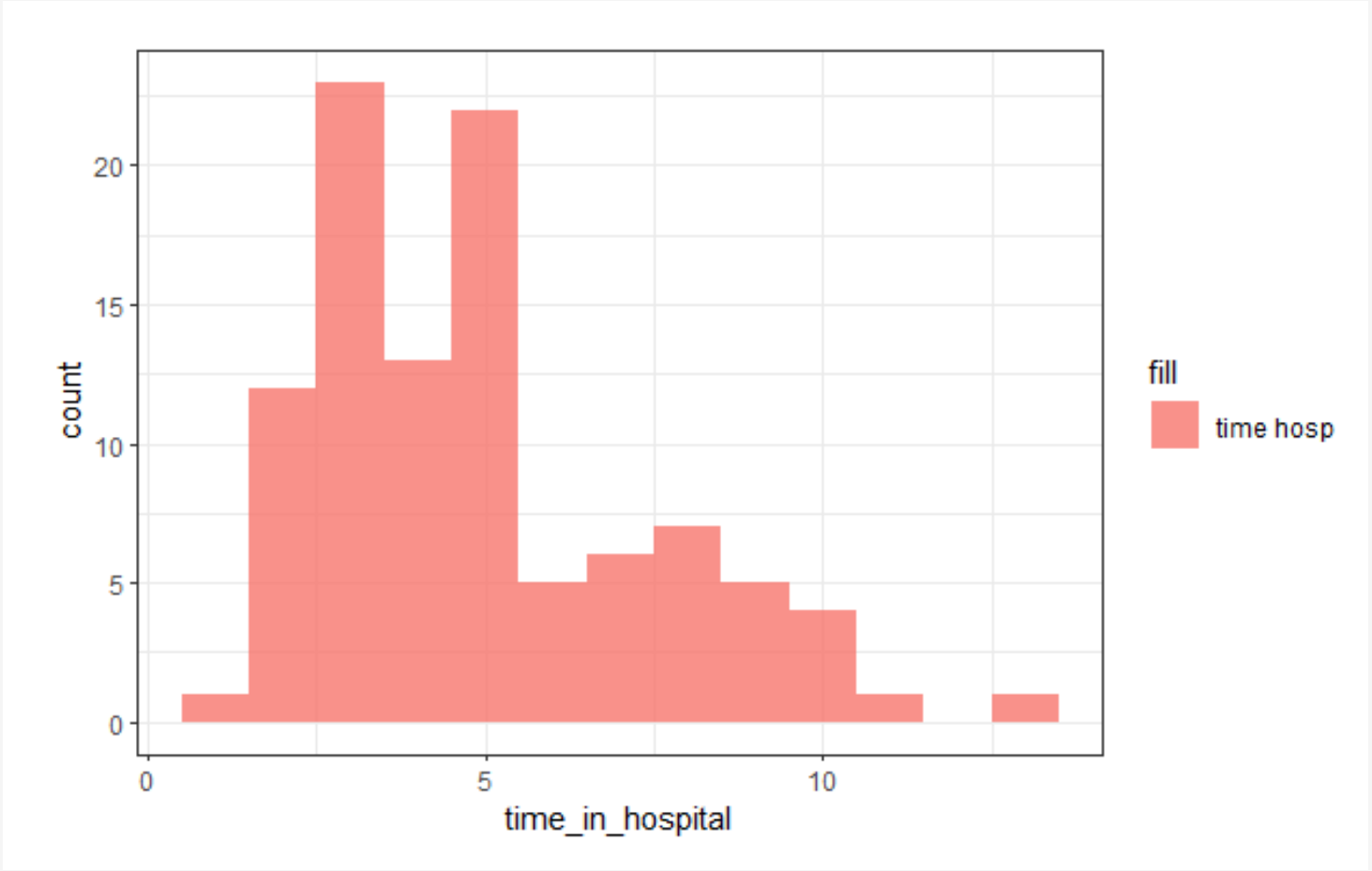
TIME IN THE HOSPITAL



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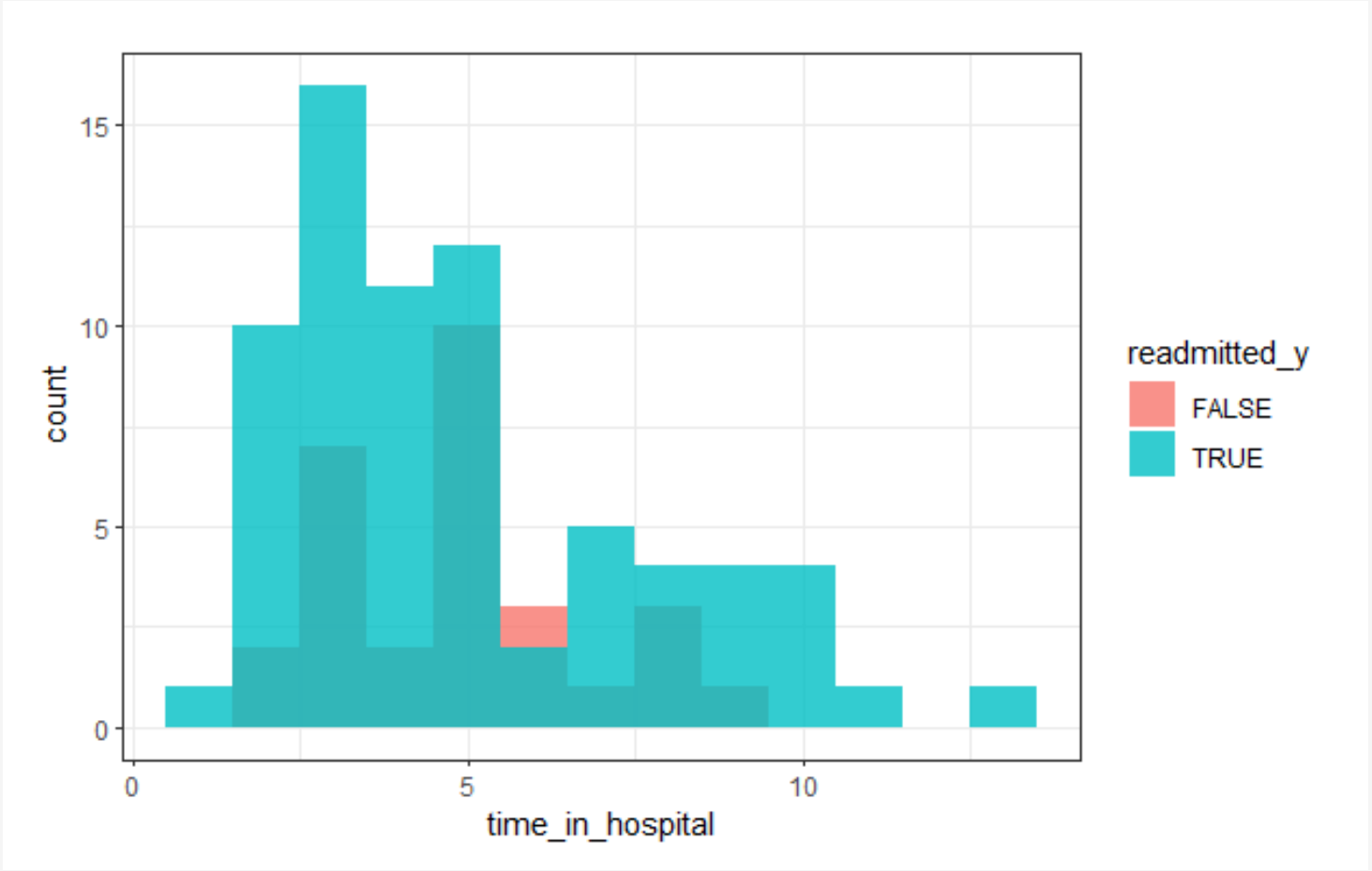
TIME IN THE HOSPITAL



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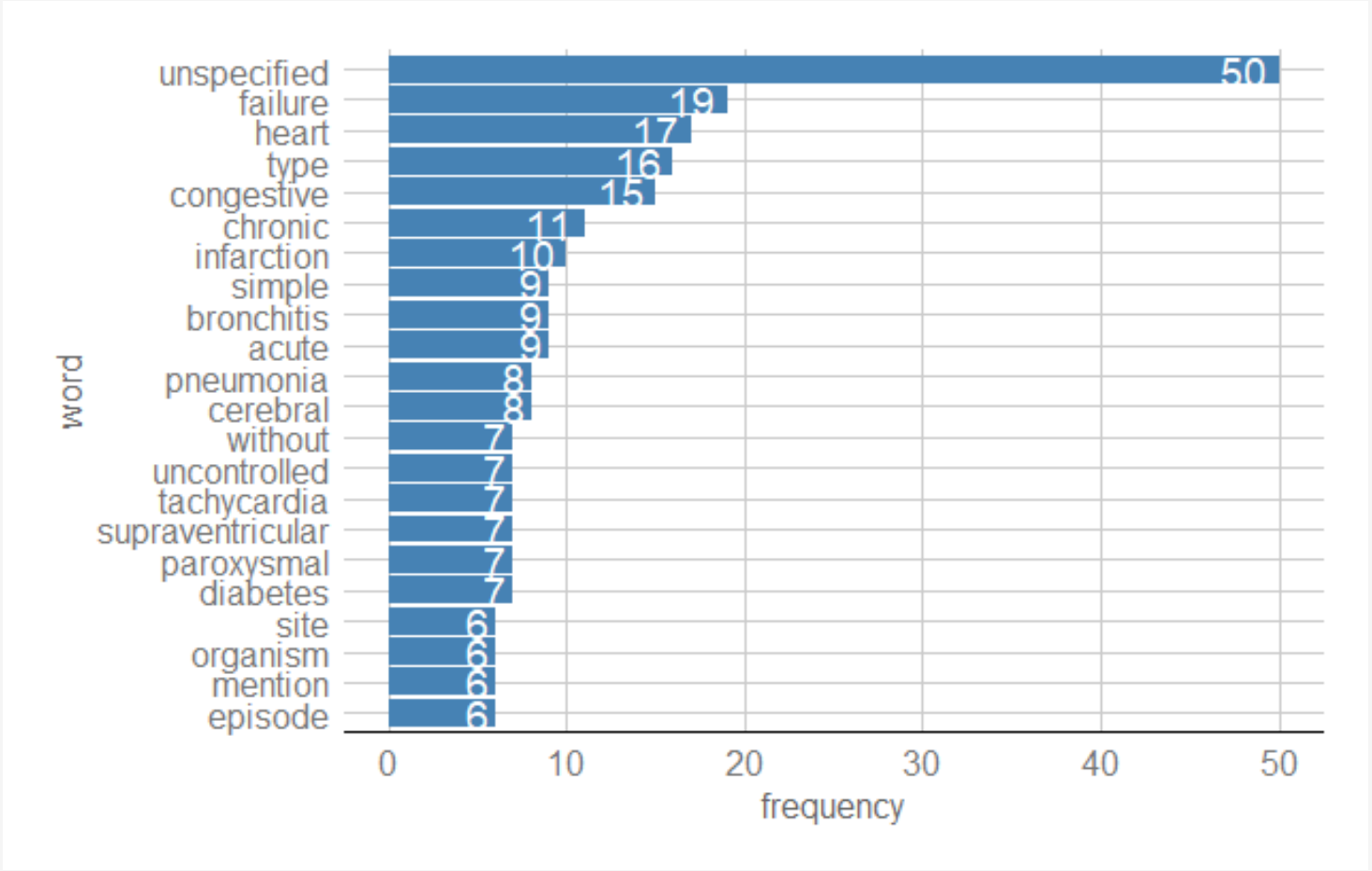
TOP WORDS IN DIAGNOSIS



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TOP WORDS IN DIAGNOSIS

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CONCLUSION

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In order to decrease readmission rates for diabetic patients, hospitals should focus on several factors

* Monitoring the number of laboratory procedures performed on a patient, as a higher number of procedures can indicate underlying health concerns and increase the risk of readmission

* Pay attention to the age of the patient, as older patients are more susceptible to developing additional health conditions that can lead to complications and readmission.

* Number of medications a patient is taking should be monitored, as patients taking a higher number of medications are more likely to be readmitted.

* Patients with multiple diagnoses and inpatient admissions are at a higher risk of readmission

* Hospitals should monitor comorbidities such as heart disease, COPD, bronchitis, pneumonia, and tachycardia in diabetic patients, as these conditions can lead to complications and readmission

By focusing on these factors, hospitals can help decrease readmission rates for diabetic patients and improve overall health outcomes.

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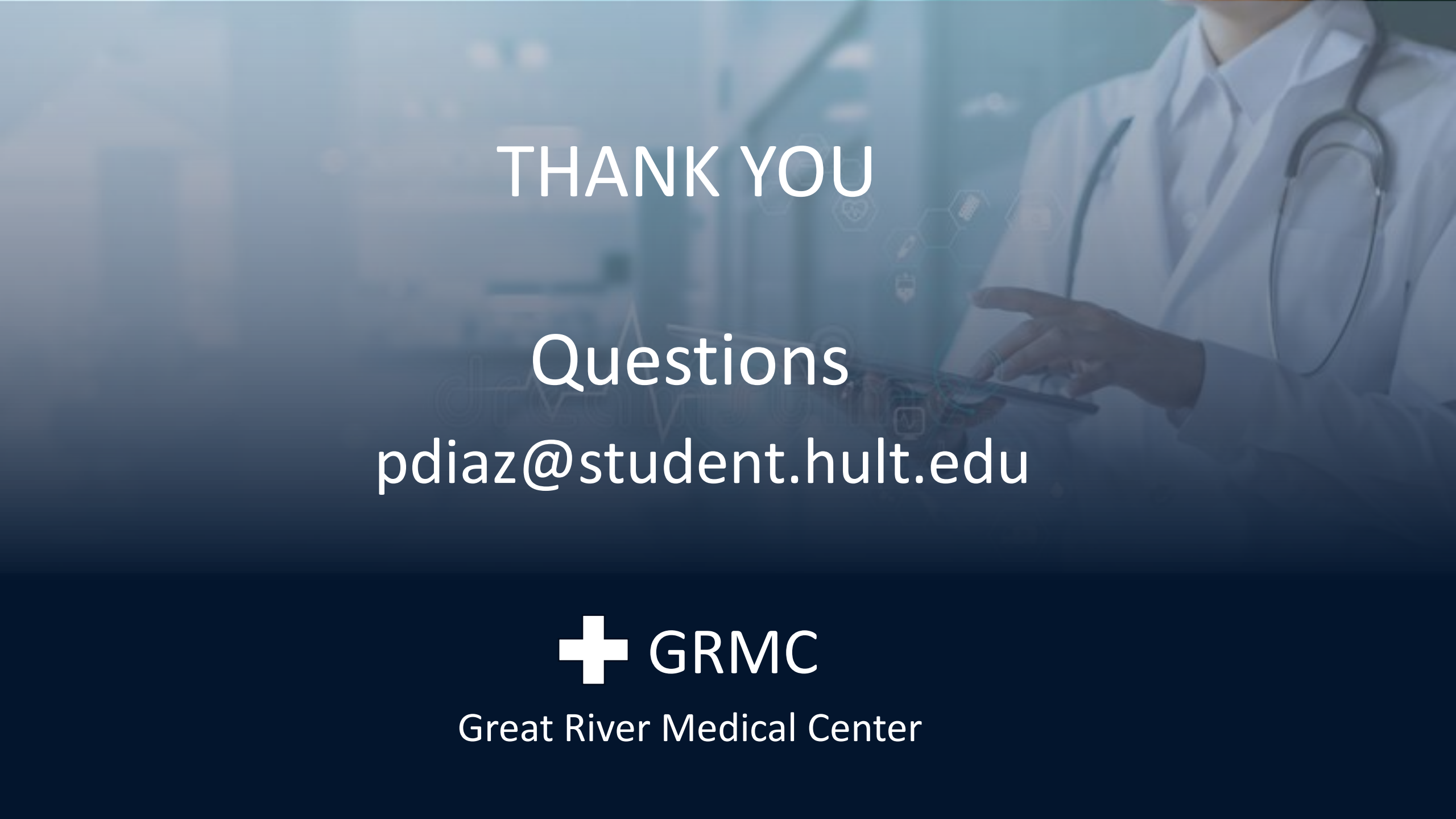

THANK YOU

Questions

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