



Analyzing ICU Patients diagnosed with Heart Failure in MIMIC-III Database

Exploratory Analysis on ICU Heart Failure Patients



Our focus with this dataset characterization task was to analyze the population of patients who had been diagnosed with Heart Failure.

Our approach was to use exploratory data analysis on different aspects of the MIMIC-III database, looking at different aspects of the data such as Gender, Age, Visits, and Procedures.

Processing and Loading of MIMIC III dataset into MySQL

Step 1 - Extract zip file contents into folder with multiple .csv files for each piece of the dataset

Step 2 - Importing of the .sql and csv data from our local files and creating indexes and constraints.

Step 3 - Replace file path locations with our local directories and run the scripts.

Path of Analysis



We choose this topic based on the MIMIC III data and initial research conducted. The study focused on patients diagnosed with heart failure. Subsequent slides go into depth to explain our findings and conclusions about the data.

- The Most Frequently Used Tables were Admissions, Patients, and ICUstay tables

Admitted Patients - Trend over time

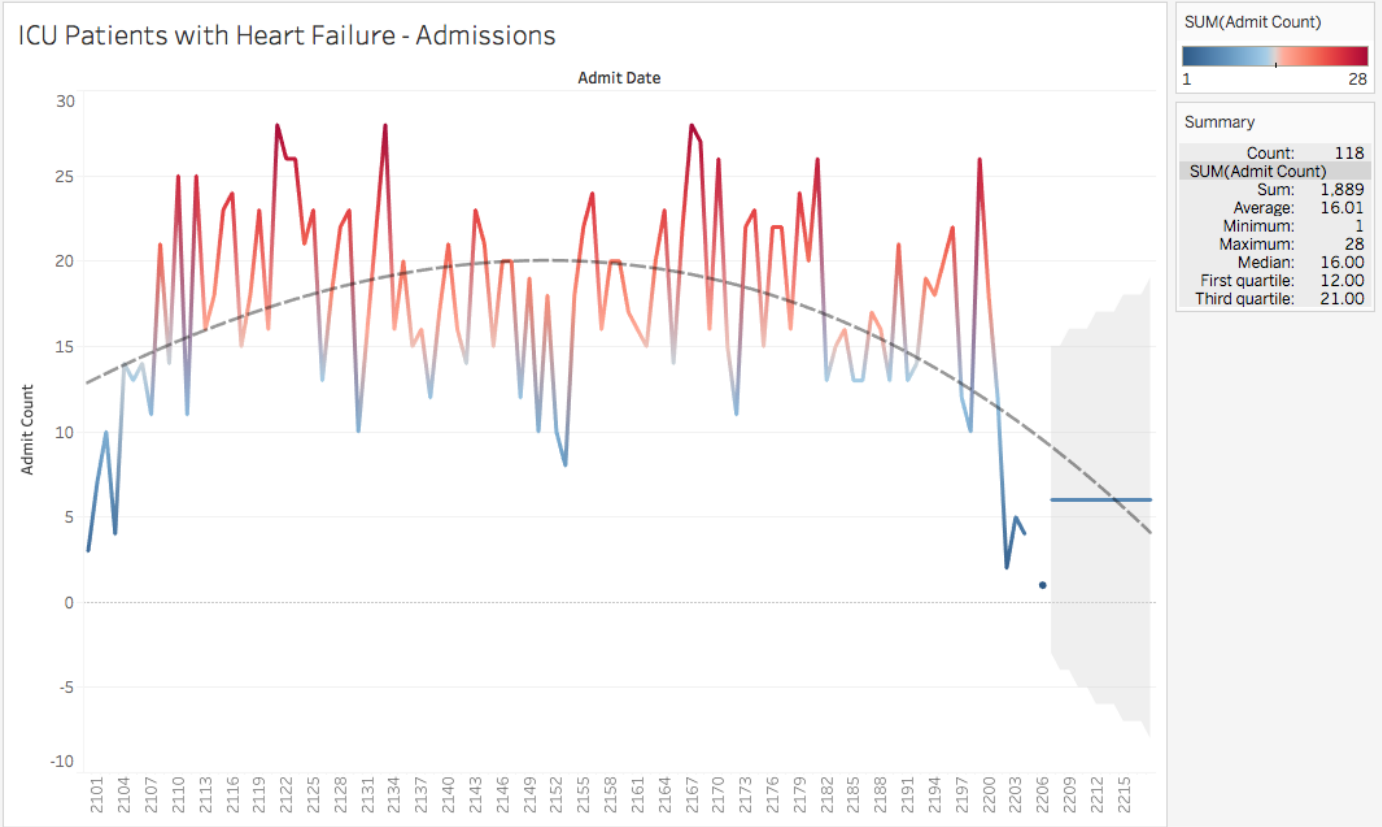
If we group the hospital admissions for ICU patients with Heart Failure by admit date, is there any sort of trend we can see of patients?

Max: 28 visits
Min: 1 visit

Trend: Downward
Polynomial regression line fitted to the data points

Average: 16.01

British study of 4 million Heart Failure patients shows similar trend



Returning Patients - Times a patient returned

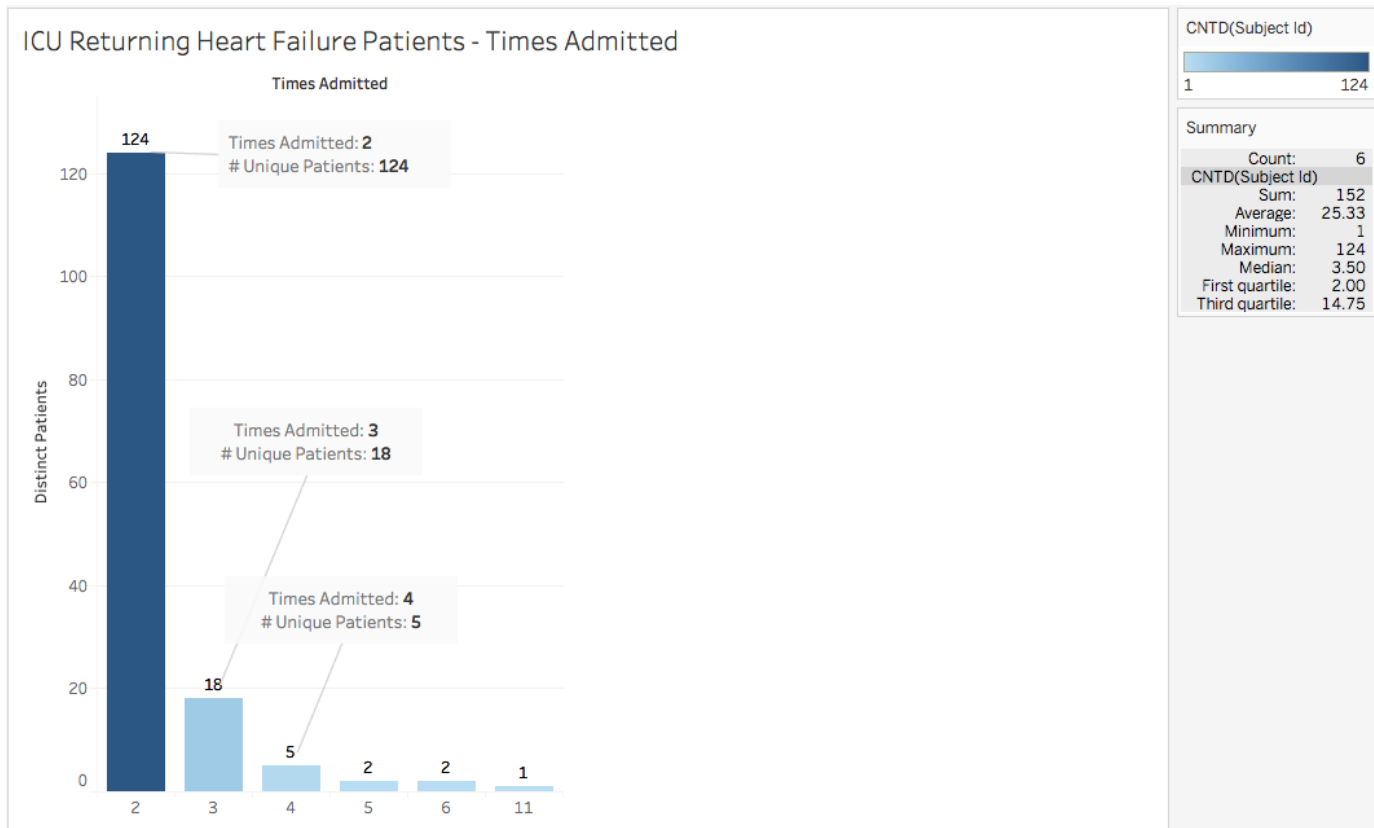
What were the number of returning ICU patients with Heart Failure?

Max: 124 patients with 2 visits
Min: 1 patient with 11 visits
(19059)

Trend: Steep drop off after second visit. Most patients receive treatment or consult within 2 visits

Total Returning: 152

Patient with 11 visits - African American, multiple ER visits



Diagnosis - Ethnicity Distribution

Top 20 diagnosis-ethnicity

- High:
- ❖ White with Pneumonia
 - ❖ Black/African American with congestive heart failure

Diagnosis-Ethnicity Distribution		
Diagnosis	Ethnicity	
ANGIOEDEMA	HISPANIC/LATINO - DOMINICAN	5
	BLACK/AFRICAN AMERICAN	176
CONGESTIVE HEART FAILURE	WHITE - RUSSIAN	13
	UNABLE TO OBTAIN	56
CORONARY ARTERY DISEASE	UNKNOWN/NOT SPECIFIED	185
	ASIAN - ASIAN INDIAN	4
CORONARY ARTERY DISEASE CORONARY ARTERY BYPASS GRAFT /SDA	WHITE - OTHER EUROPEAN	5
	PATIENT DECLINED TO ANSWER	10
CORONARY ARTERY DISEASE CORONARY A..	ASIAN - FILIPINO	5
DIABETIC KETOACIDOSIS	ASIAN - VIETNAMESE	4
GASTROINTESTINAL BLEED	OTHER	27
INTRACRANIAL HEMORRHAGE	ASIAN	38
	ASIAN - CHINESE	13
	BLACK/AFRICAN	4
	BLACK/CAPE VERDEAN	10
	BLACK/HAITIAN	5
	HISPANIC OR LATINO	42
	HISPANIC/LATINO - PUERTO RICAN	12
	WHITE	1,166
	BLACK/HAITIAN	5
SEPSIS		

Observations

What were the frequent observations on ICU patients with Heart Failure?

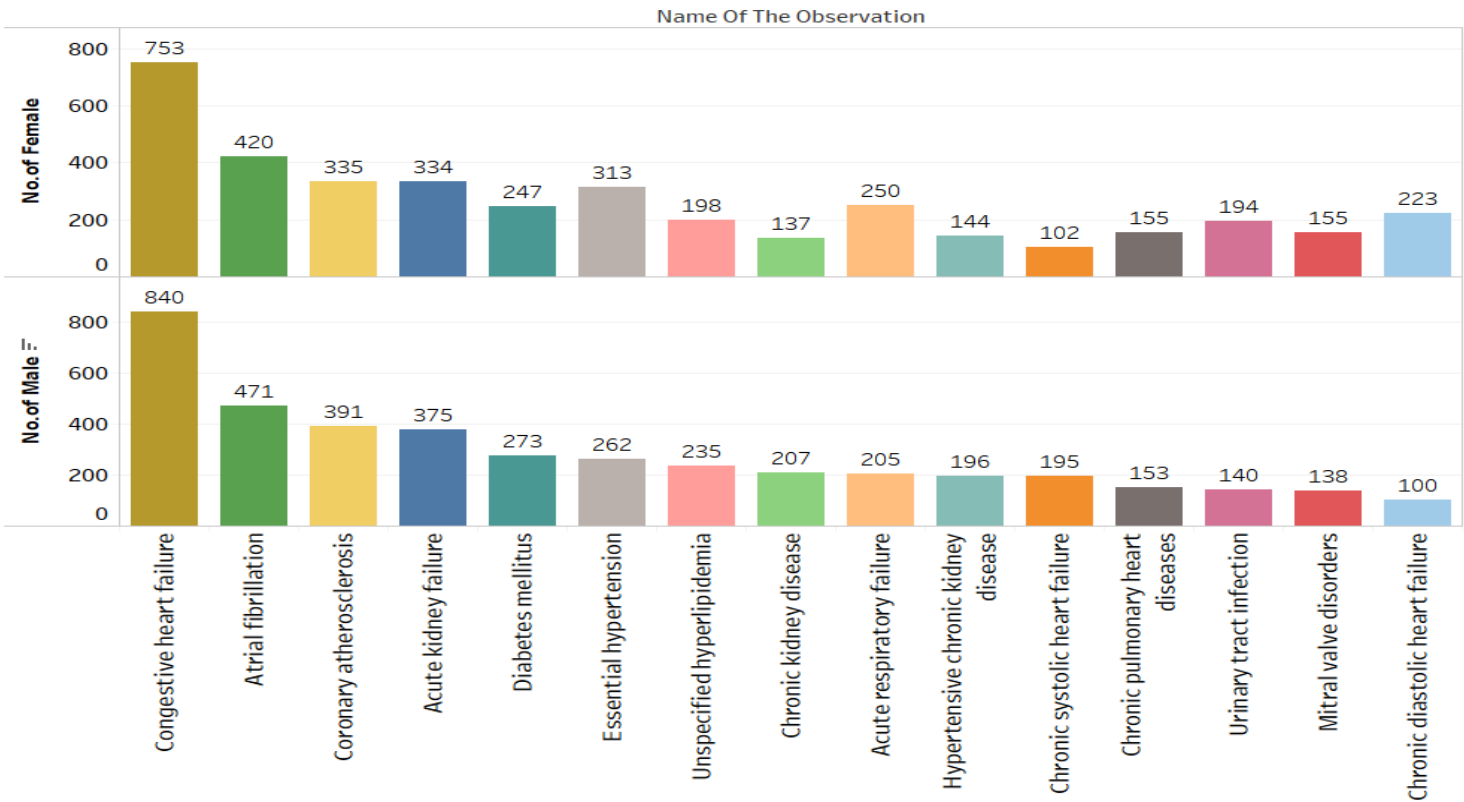


MIMIC records
observations with a
sequence number

Common observation

- ❖ Congestive heart failure
- ❖ Atrial fibrillation

Top 15 Observations



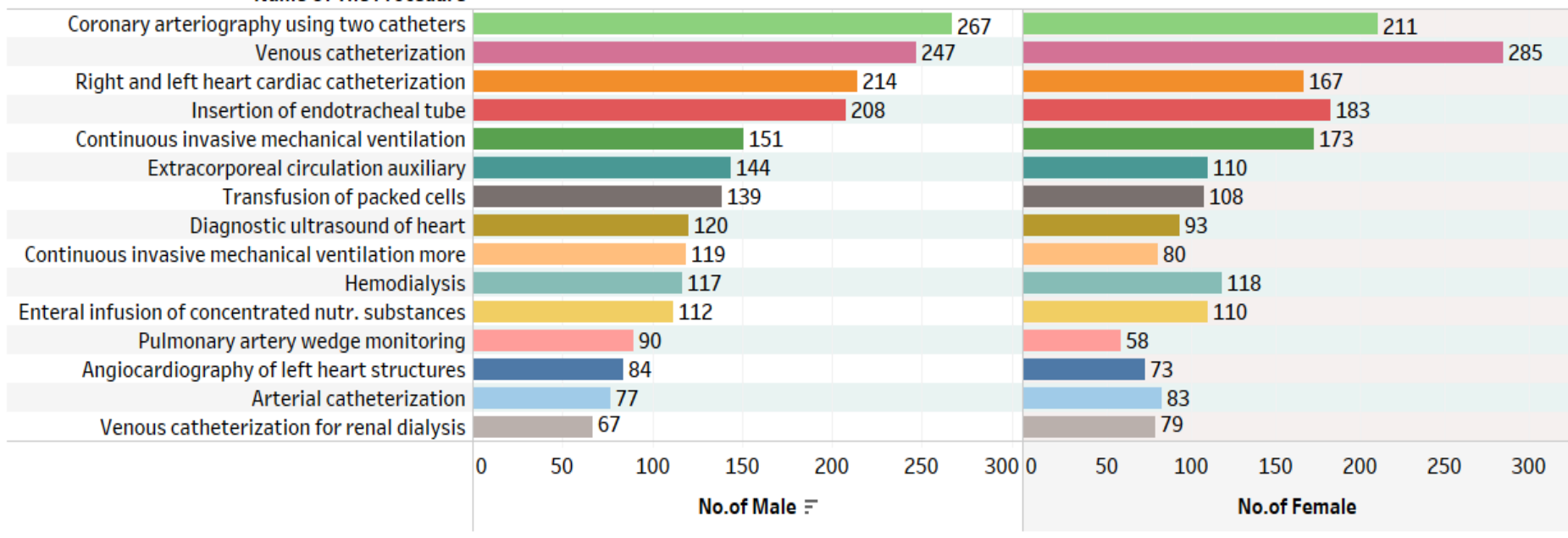
Procedures

What was the procedures given distribution among ICU patients with Heart Failure?

- ❖ Procedures are recorded in sequence order for each subject
- ❖ Max - Coronary arteriography and Venous catheterization

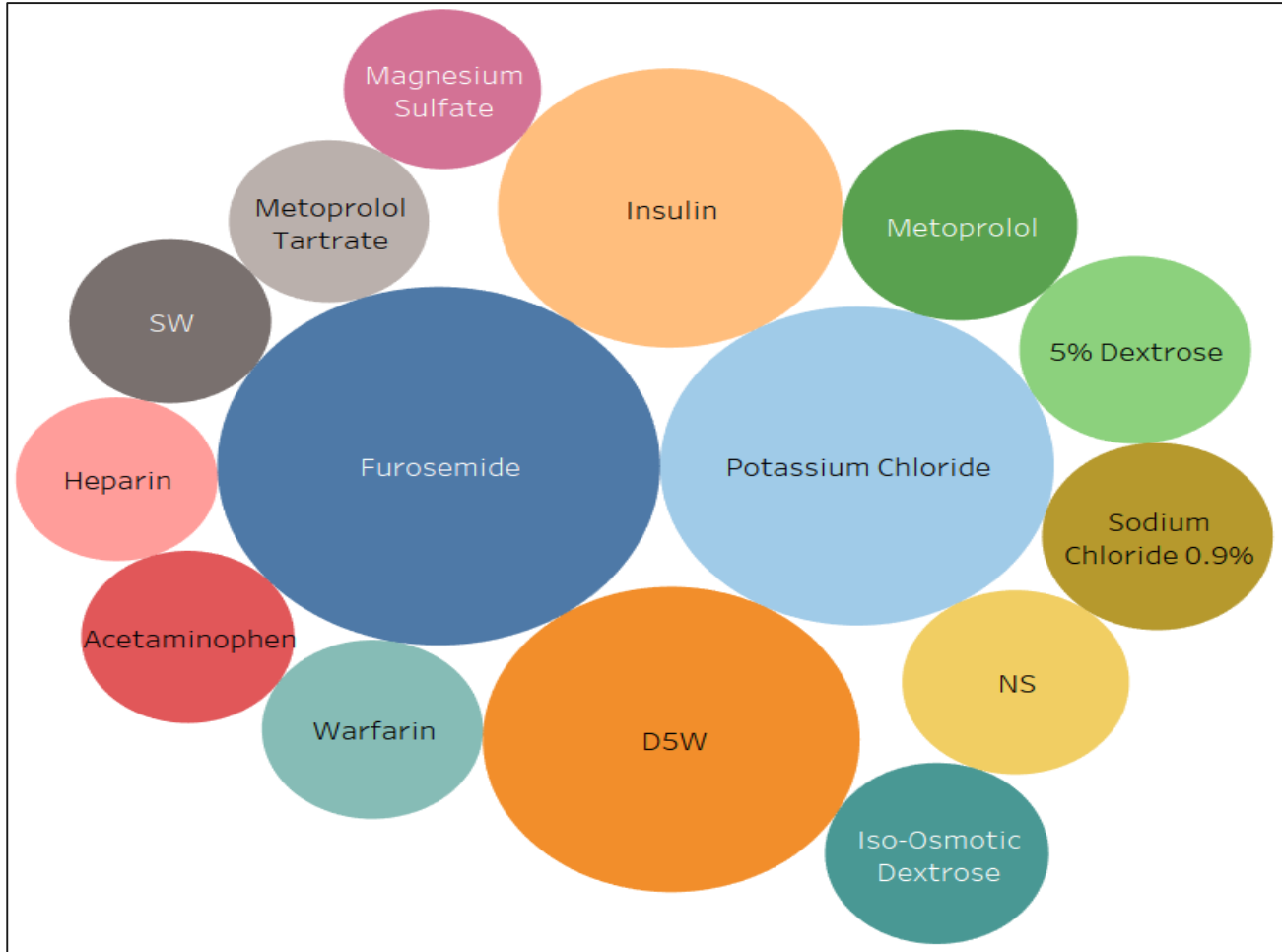
Top 15 procedures

Name Of The Procedure



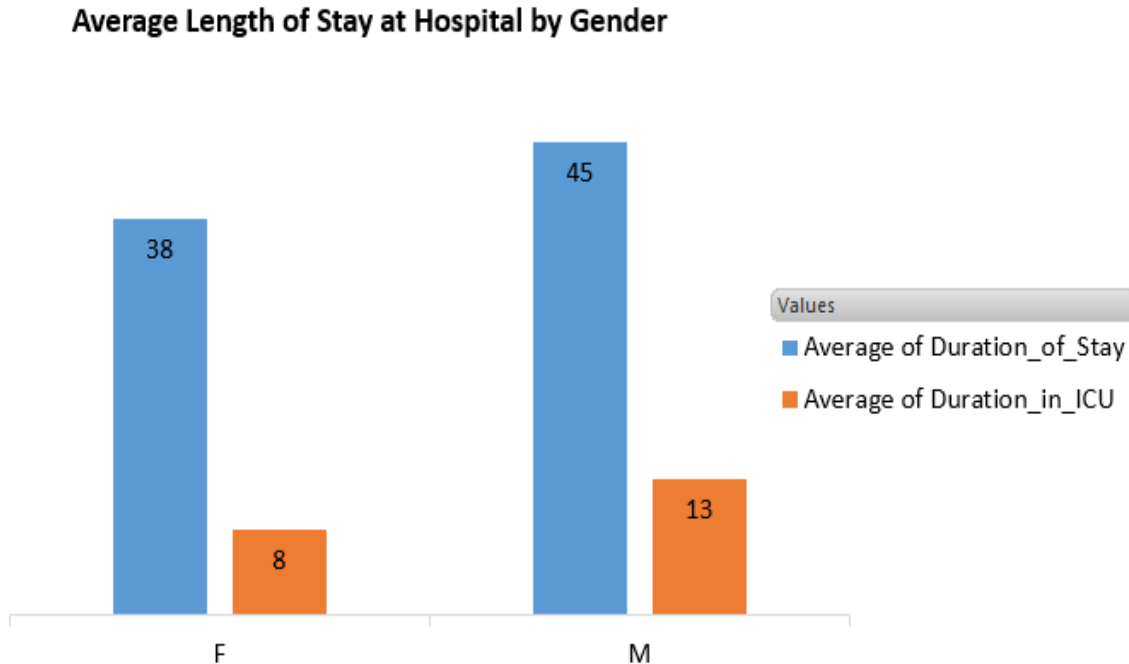
Major drugs

- ❖ **Furosemide**, diuretics used to treat edema caused by congestive heart failure
- ❖ **Potassium chloride** to treat the heartbeat irregularities
- ❖ 80% of the patients prescribed



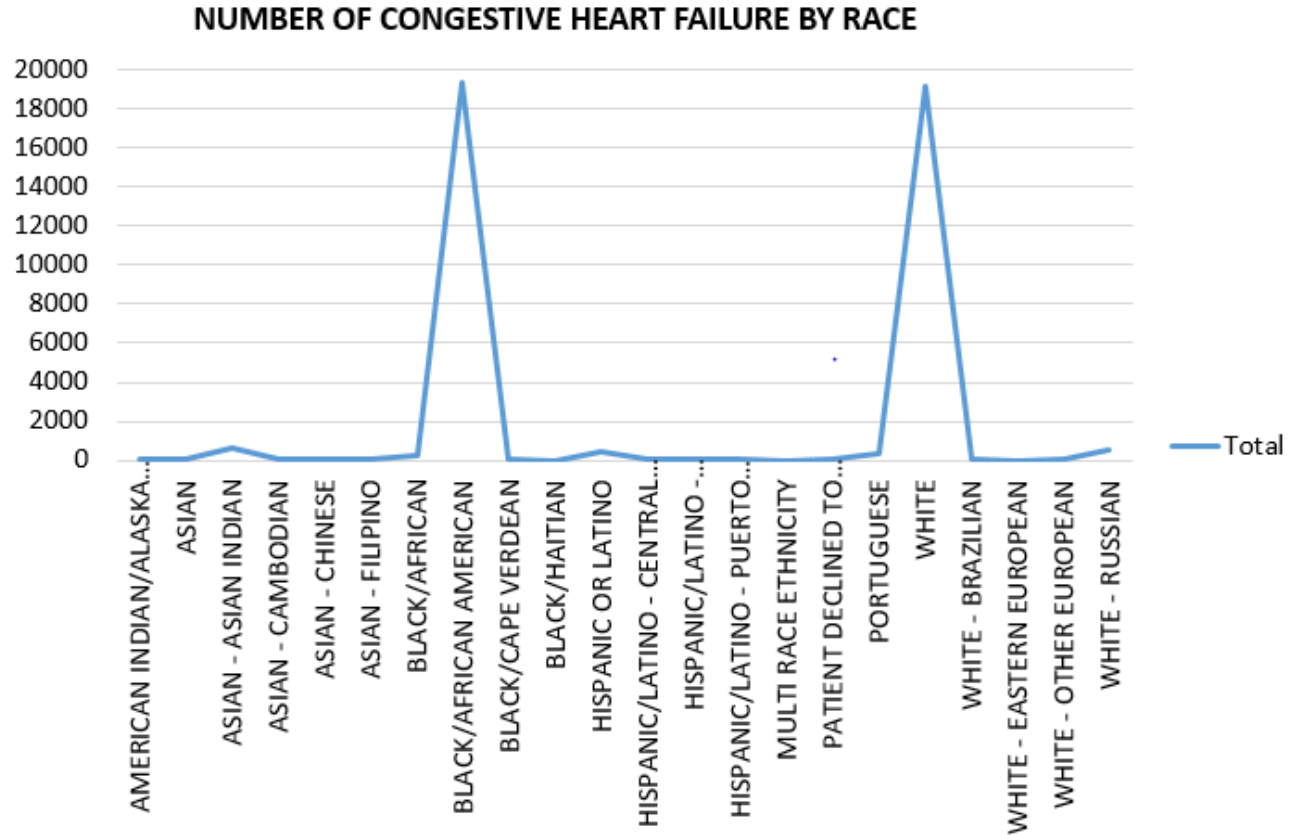
Length of Stay at Hospital by Gender

- ❖ Men spent longer times in ICU than the females.
- ❖ On average, men are more likely to stay in ICU 5 days longer than females.



Demographic Insight

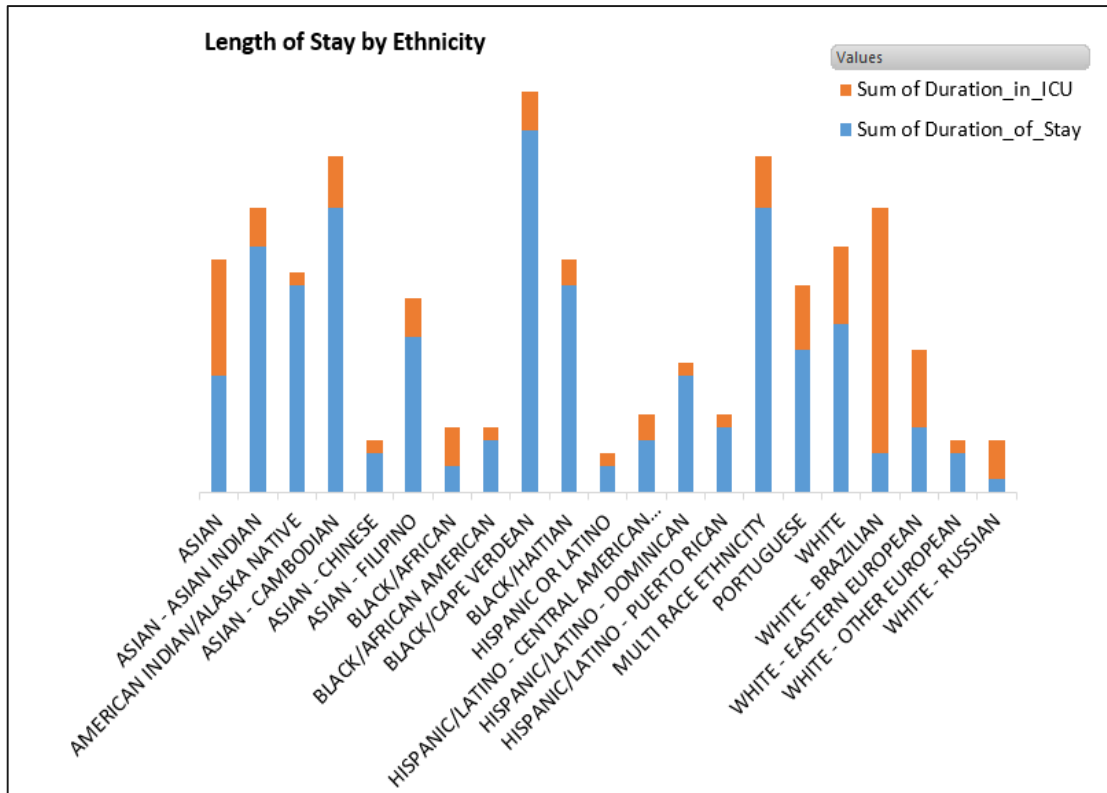
- ❖ Overall, Black and White Americans had the higher risk of heart failure in the study.
- ❖ Almost 19,000 patients each were diagnosed with Congestive Heart Failure for top category.



Ethnicity

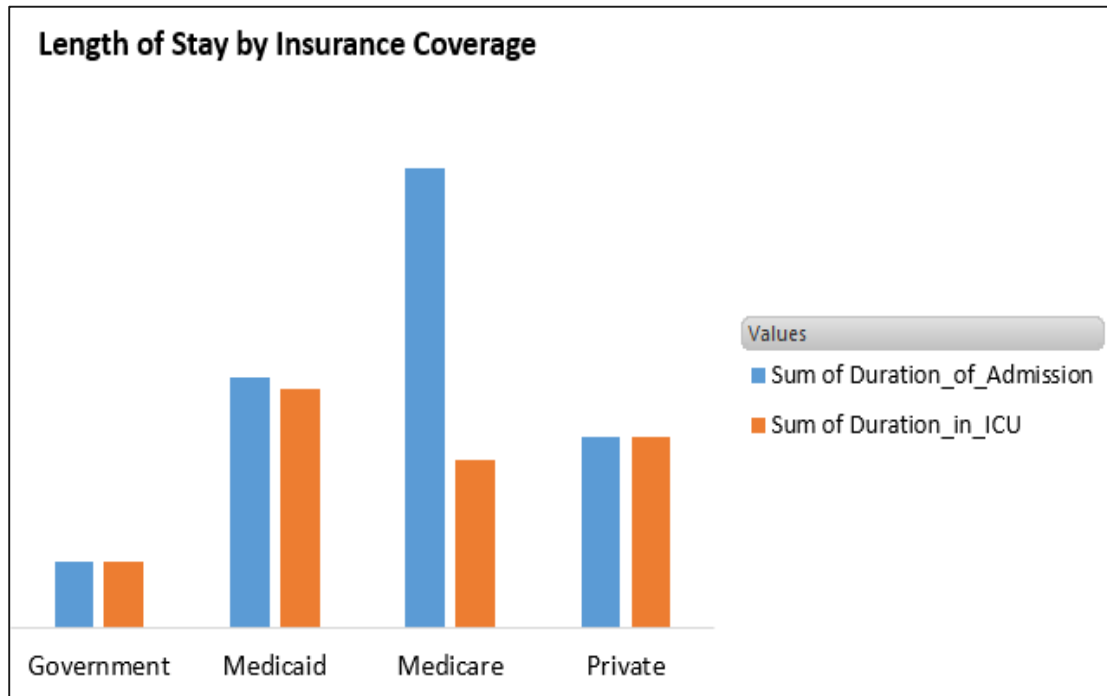


- ❖ What is interesting is that, Blacks stayed in the ICU for shorter periods whereas Whites stayed in ICU for longer periods.
- ❖ Why is it so? Is it related to inadequate access to healthcare, rate of recovery of patients, or maybe poverty. This is something that can be further looked into.



Congestive Heart Failure Insurance Coverage

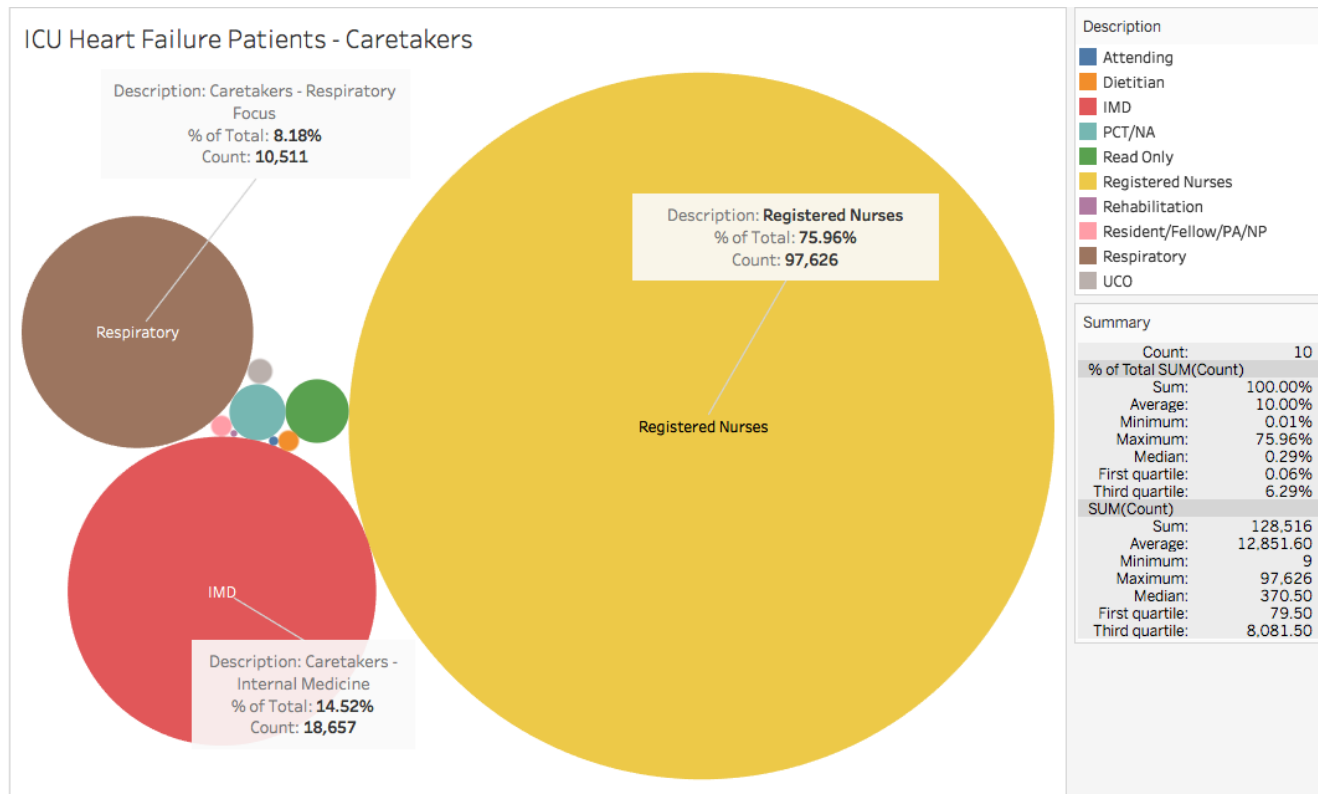
- ❖ Health coverage to patients are mostly provided by Medicare. This is indicative of the fact that most of patients in the data are above 89 years old.
- ❖ Medicare claims are highest at the initial stage of treatment and lowest when disease advances.
- ❖ Saving towards long-term healthcare is highly recommended.



Caregivers - Heart Failure ICU patients

What were the number of returning ICU patients with Heart Failure?

Registered Nurses were the most common in aiding patients with Congestive Heart Failure. They assumed over 75% of the caretakers assigned to patients with Congestive Heart Failure with a count of close to 98 thousand






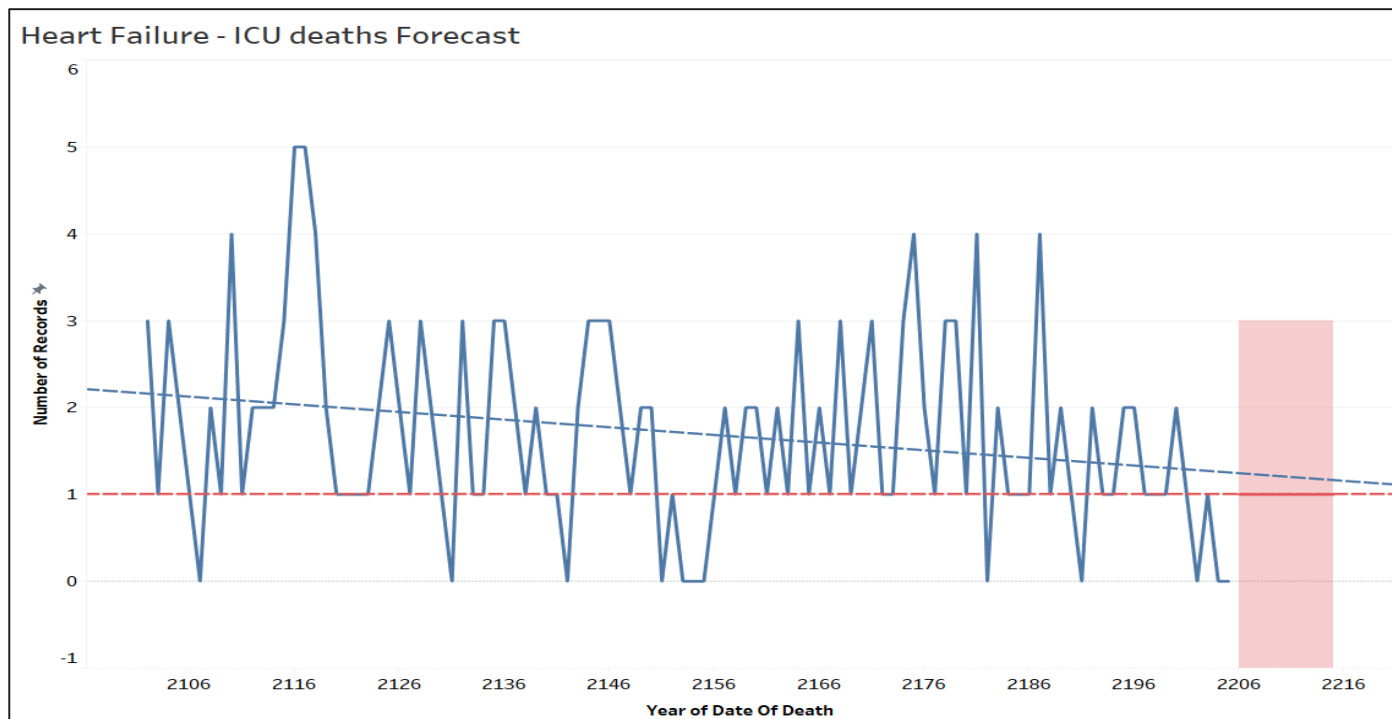
Mortality rate

What were the mortality rates among ICU patients with Heart Failure?

- ❖ ICU deaths - 178
- ❖ Max per year - 5
- ❖ 50% of patients from CCU (Coronary Care Unit)
- ❖ Exponential smoothing forecast


Current Data from MIMIC →

Result Grid				Filter Rows: <input type="text"/>	Export: 	Wrap Cell Content: 
	NO. OF HEART FAILURE PATIENTS DIED WHILE IN ICU			MALE	FEMALE	%MALE %FEMALE
	178			98	80	55.06 44.94



Secondary Analysis of Electronic Health Records

Chapter 21 - Mortality Prediction in the ICU


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- ❖ Patients admitted to the ICU suffer from critical illness or injury and are at high risk of dying.
 - ❖ The risk of death can be approximated by evaluating the severity of a patient's illness as determined by important physiologic, clinical, and demographic determinants.
 - ❖ Using machine learning algorithms to classify patients as alive or dead at 30 days after hospital discharge.

Chapter 23 - Comparative Effectiveness: Propensity Score Analysis

- ❖ In order to identify those patients with atrial fibrillation and rapid ventricular response (Afib with RVR) in the dataset, we used a combination of structured and unstructured data.
- ❖ Propensity score analysis has been used to compare two treatment groups, i.e. treatment versus control group.

Secondary Analysis of Electronic Health Records

MIMIC II VS MIMIC III

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- ❖ MIMIC-III is an extension of MIMIC-II: it incorporates the data contained in MIMIC-II (collected between 2001 - 2008) and augments it with newly collected data between 2008 - 2012.

Demographics table MIMIC II VS MIMIC III

- ❖ In MIMIC III there is not a table only for demographics the demographics for MIMIC III is into admissions and patients table. The admissions table contain information the whole hospital database, unlike the demographics on MIMIC II only contain information regarding patients staying in the ICU.

Closing Remarks



- ❖ Managing the datasets better
- ❖ Creation of temporary tables for subqueries
- ❖ Use of sampling and selection techniques to speed up computation or analysis
- ❖ Creation of triggers to capture the updates on tables for audit purpose



Thank you