Kidney Disease Patients

Analysis of death during the ICU

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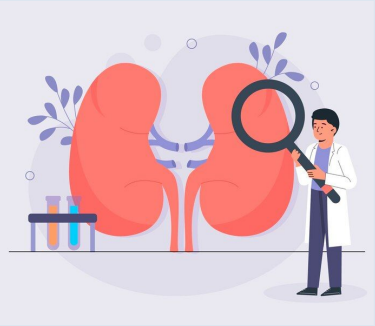

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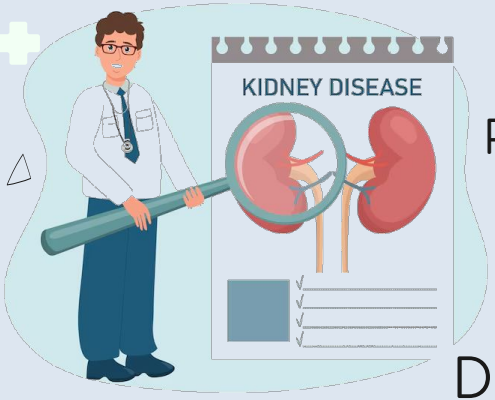
BACKGROUND

47% of the total patients dataset suffer from Chronic Kidney Disease (CKD) or suffered from Acute Kidney Failure.



Target Population

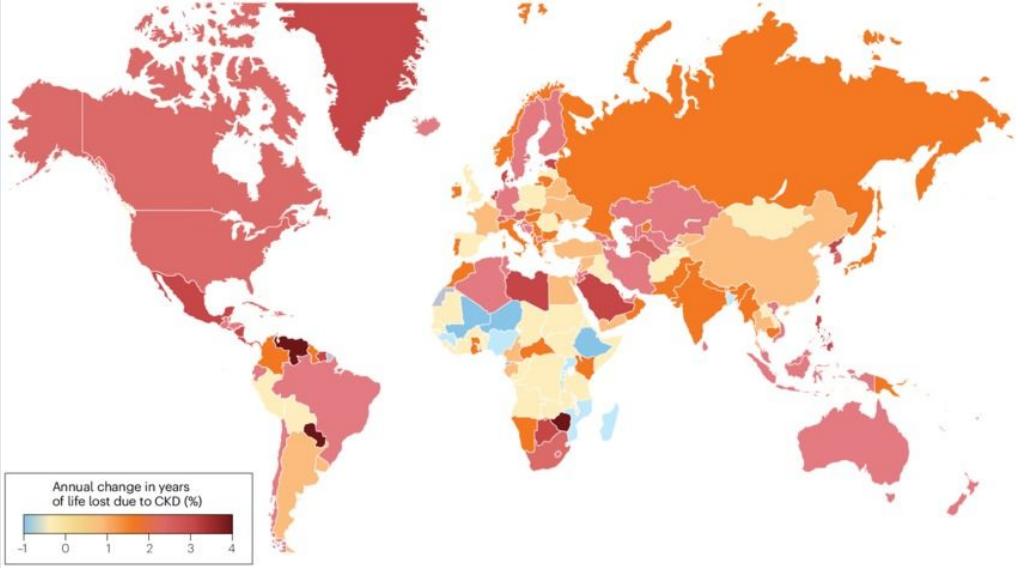
Patients who received one diagnosis related to kidney diseases

Result Variable

Did the patient die during its ICU stay or not ?

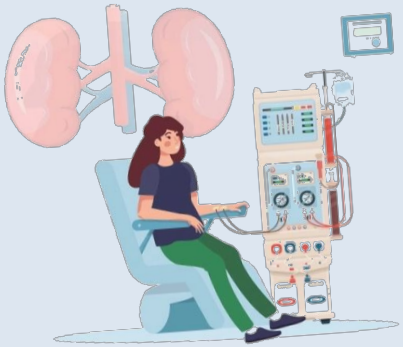
Annual death due to CKD - Global

Around 15% of U.S. adults, or approximately 37 million people, have CKD



High-Risk Groups in US:

- African Americans
- Hispanics
- Native Americans
- Asian Americans



Statistic Highlights

10% of global population have CKD

38% of adults aged 65+ have CKD

US: 29% of patients with ESRD* live with kidney transplant

*ESRD: end-stage renal disease

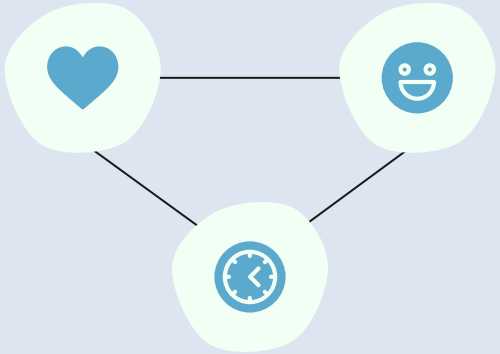
RESEARCH QUESTION

How do demographic factors, secondary diagnoses and test results predict mortality during ICU stay in patients with kidney disease ?

PREDICTORS

DEMOGRAPHIC

- Gender
- Age
- Insurance status
- Ethnicity



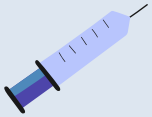
DIAGNOSIS

- Diabetes mellitus or type II
- Urinary infection
- Depressive disorder

LAB & TEST RESULTS

- Creatinine
- Blood Urea Nitrogen (BUN)
- Heart Rate

PREPROCESSING



01

Tables

Combining the various tables from MIMIC III

02

Predictors

Keeping demographic columns and creating new binary columns for relevant chosen diagnosis

03

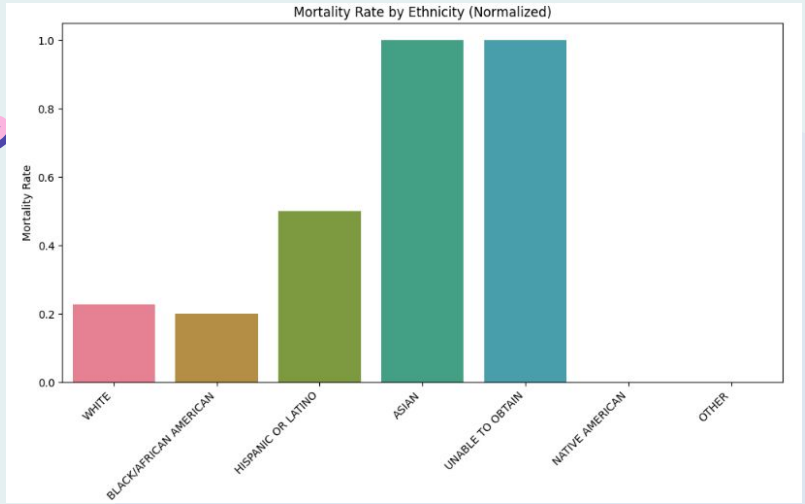
Multiple tests

Creating new columns for test predictors: first entry, max & mean

04

Missing Values

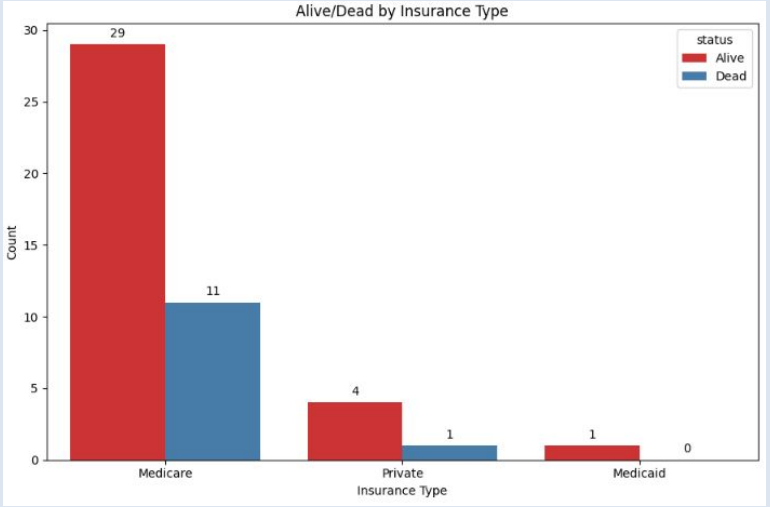
Filling missing and problematic values

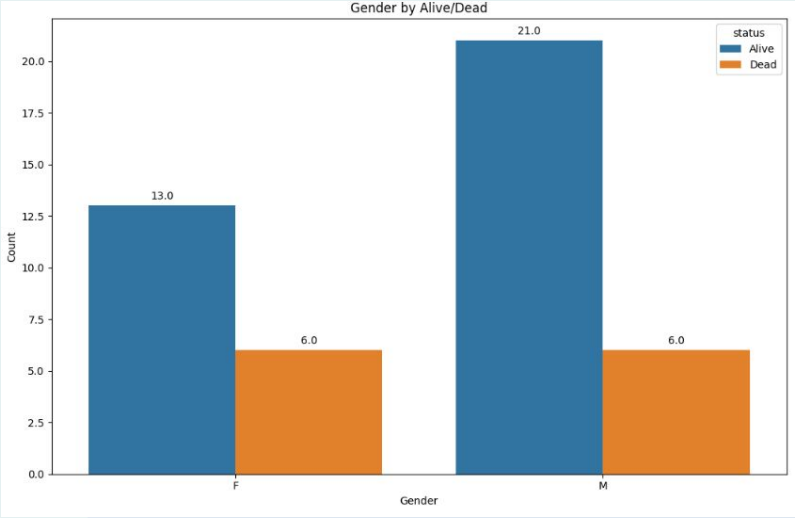


Mortality Rate by Ethnicity

Mortality by Insurance Type

Total Medicare spending on CKD was $75 billion in 2020



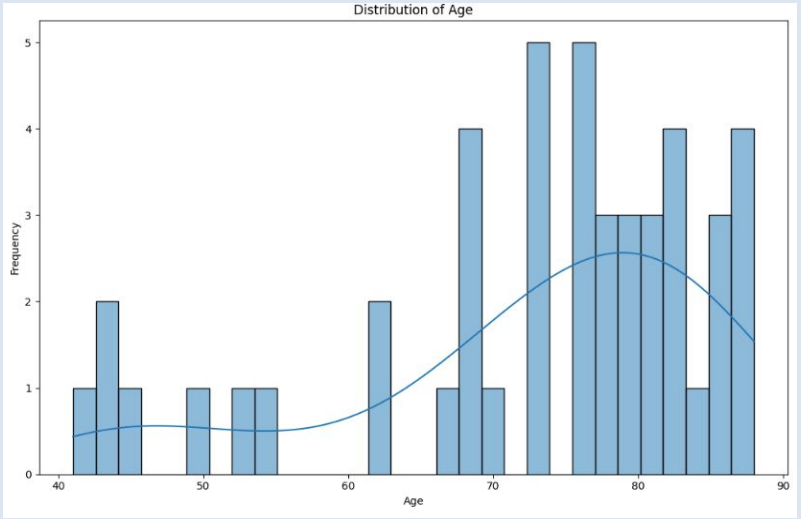


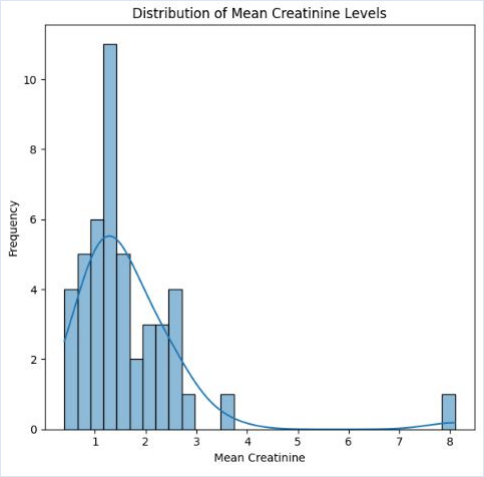
Mortality by Gender

- 31.5% of female died
- 22% of men died

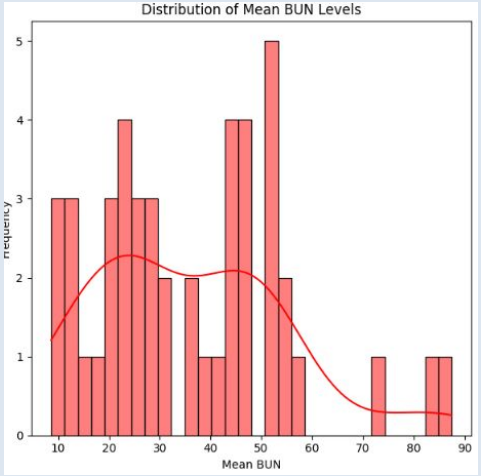
Age Distribution in the target population

Majority 60+

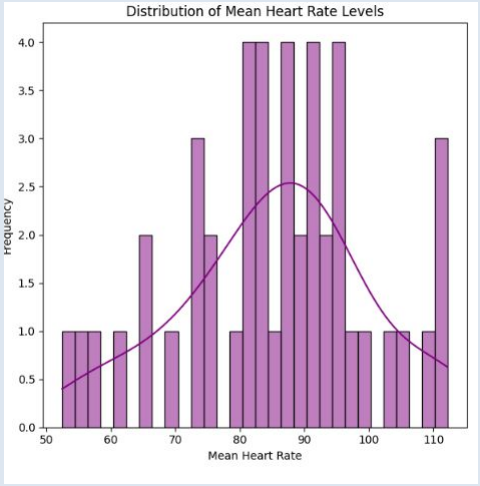




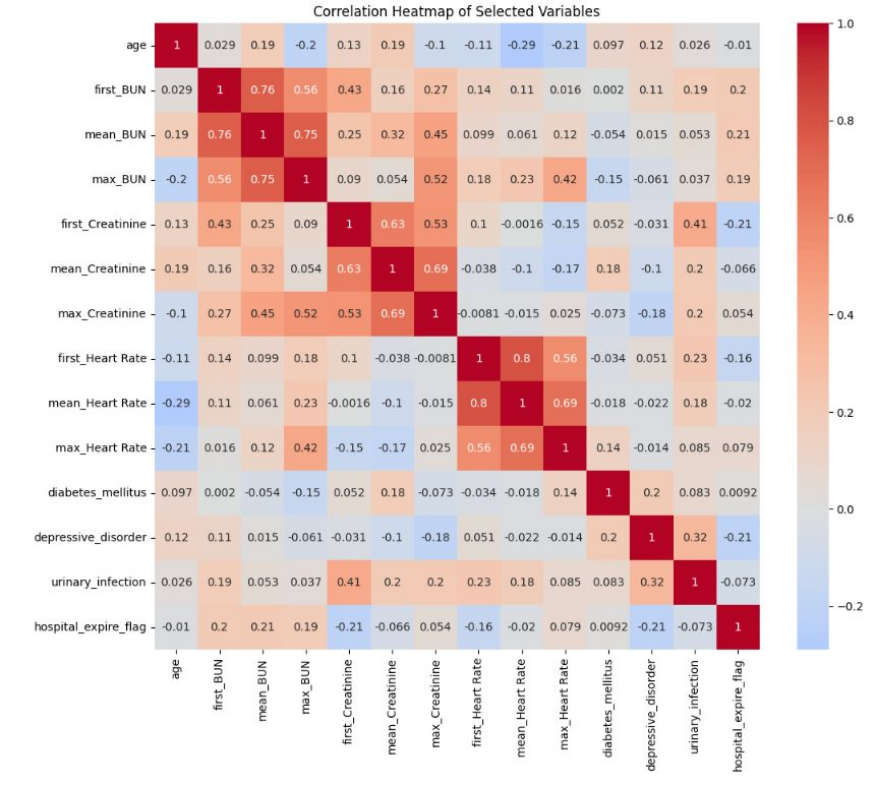
Normal Range of Creatinine:
0.7 to 1.3 mg/dL



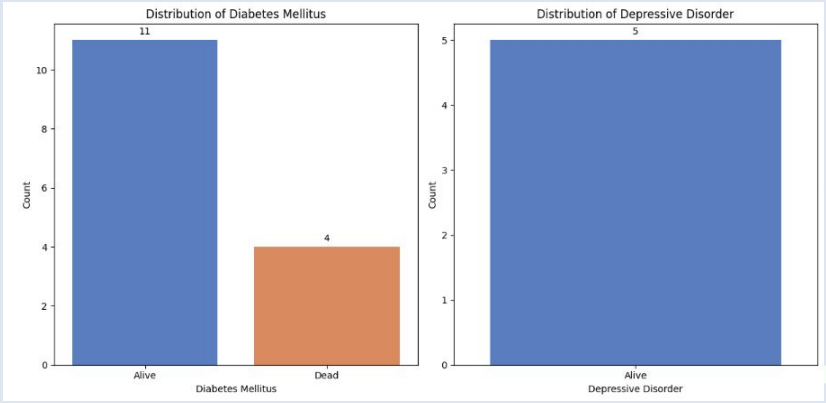
Normal Range of BUN:
7 to 20 mg/dL

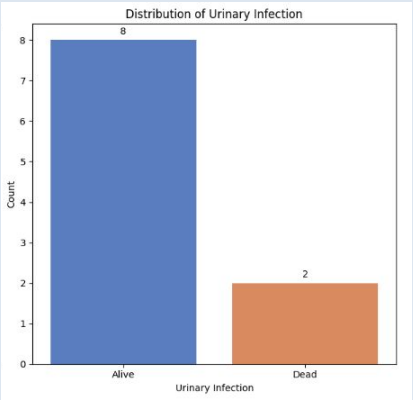


Normal Range of Heart Rate:
60 to 100 bpm



There are no significant correlations





50% of the patients that died received at least one of the diagnosis predictors

RESULTS

```
T-test for age: t_stat=0.06923367171705226, p_value=0.9451173153124106
T-test for mean_Creatinine: t_stat=0.44074161983850324, p_value=0.6615580210764506
Mann-Whitney U Test for mean_BUN: U_stat=141.0, p_value=0.11786100553396059
T-test for mean_Heart Rate: t_stat=0.1354189287835617, p_value=0.8928982926625598
Chi-Square Test for gender: chi2=0.13736001223101335, p_value=0.7109197515495319
Chi-Square Test for diabetes_mellitus: chi2=0.0, p_value=1.0
Chi-Square Test for depressive_disorder: chi2=0.7529172644667624, p_value=0.3855541764532162
Chi-Square Test for urinary_infection: chi2=0.007829520697167748, p_value=0.9294915405421293
```

- Non-White groups = more risk to die during ICU stay
- Higher risk of dying for females
- Majority of patients (90%) show abnormal lab results
- Lab results supports relevant diagnosis
- No influence on death regarding insurance type
- No significant influence of predictors on their own on death

RECOMMENDATIONS

- Increase the sample dataset
- Collect socio-economical and habits data on patients
- Need of predictors combination to check influence on death - functions and ML

THANKS!

QUESTIONS?

BIBLIOGRAPHY

- Hou, N., Li, M., He, L. *et al.* Predicting 30-days mortality for MIMIC-III patients with sepsis-3: a machine learning approach using XGboost. *J Transl Med* 18, 462 (2020). https://doi.org/10.1186/s12967-020-02620-5
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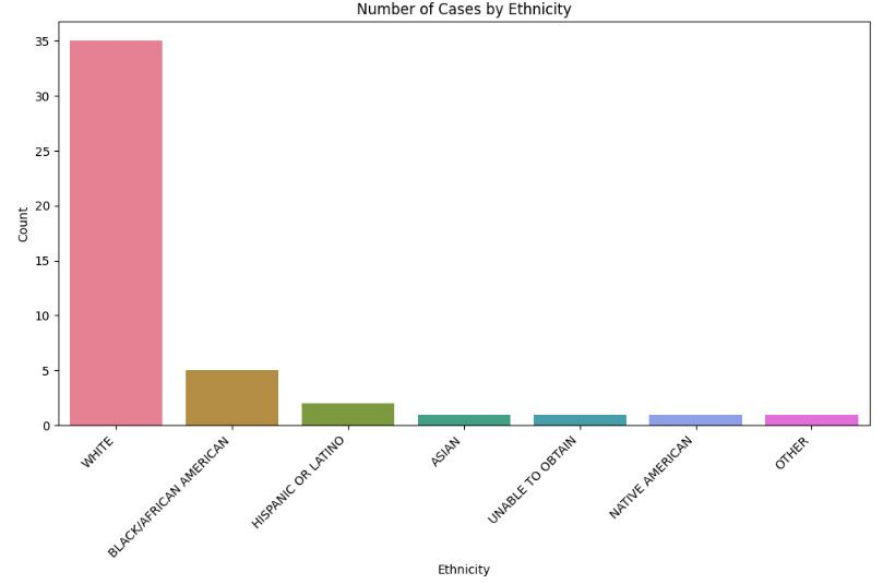
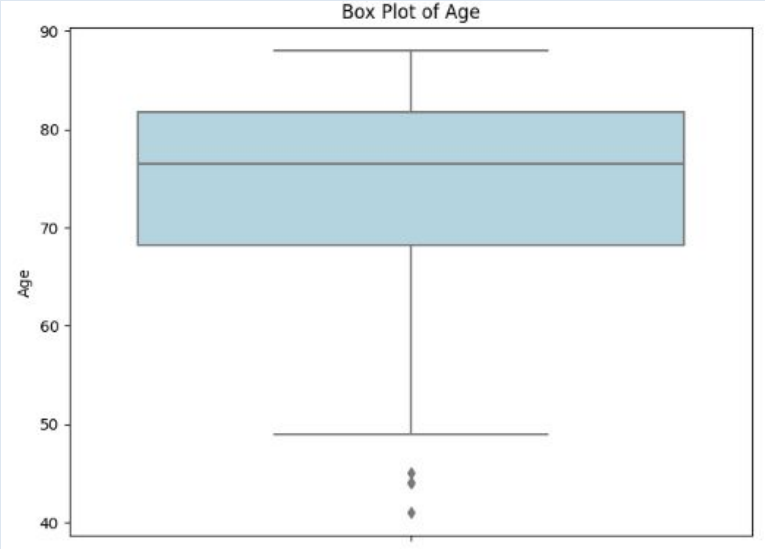
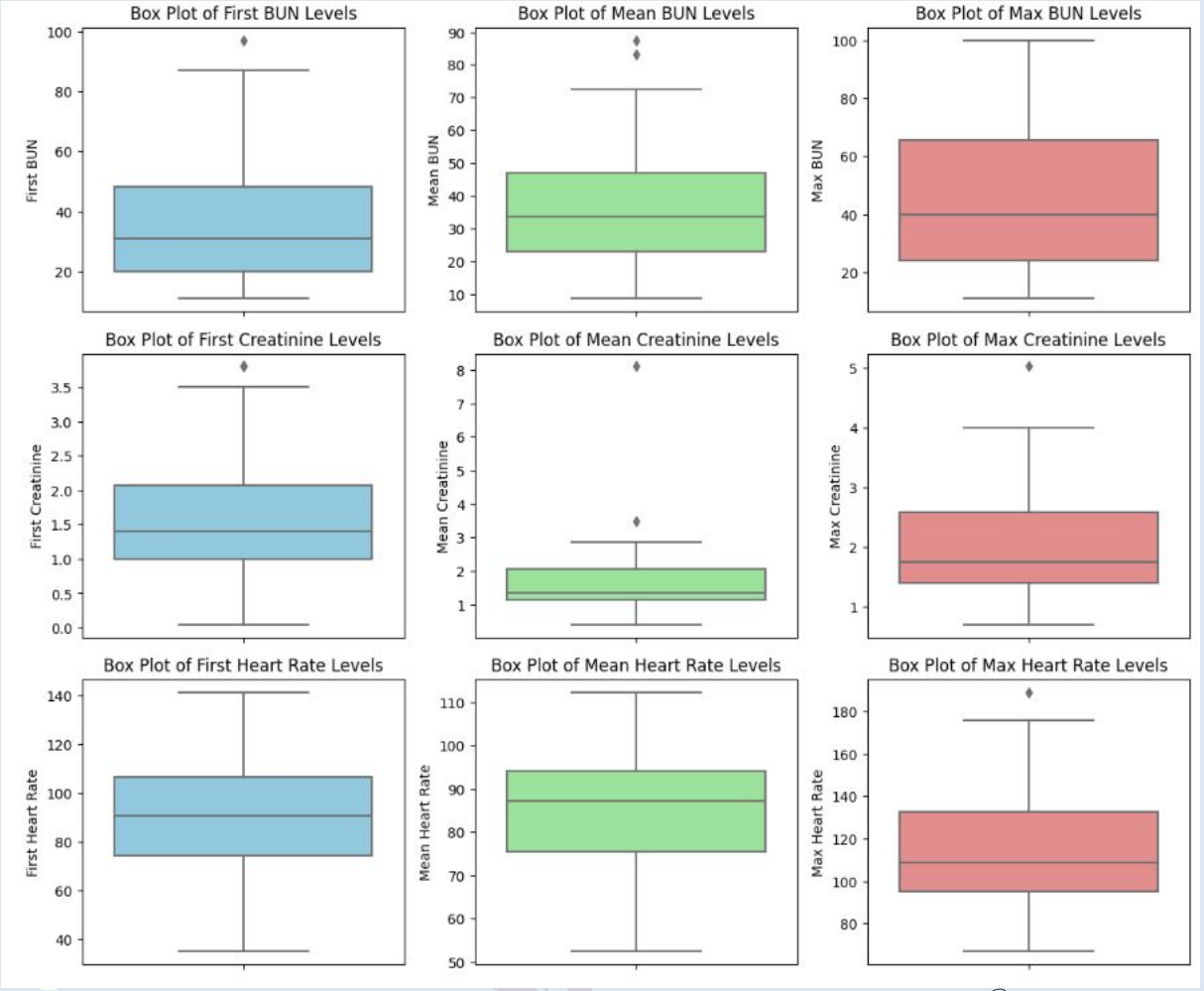
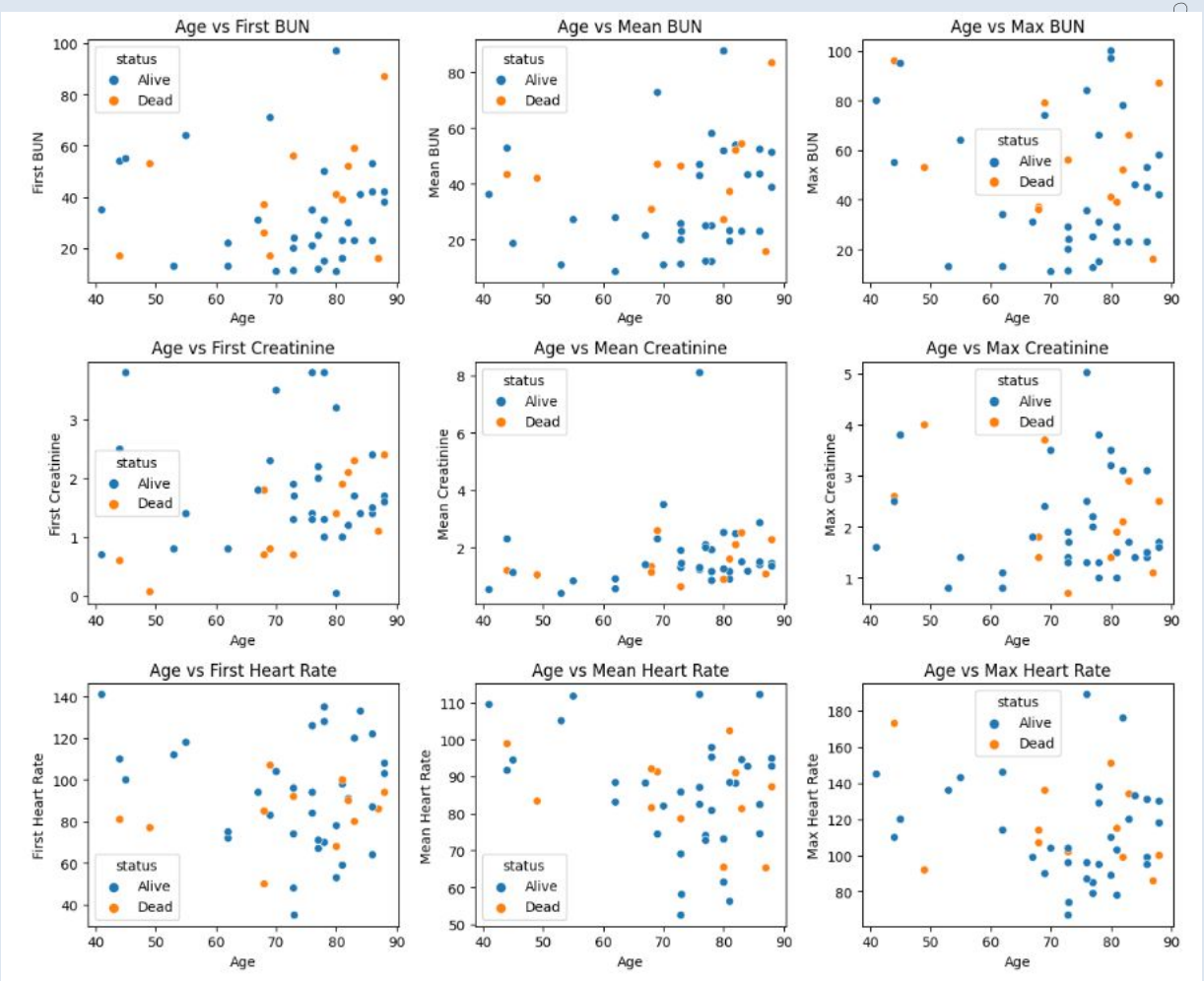
- https://www.niddk.nih.gov/health-information/health-statistics/kidney-disease
- https://nccd.cdc.gov/CKD/Documents/CKD_FactSheet_2023.pdf#:~:text=URL%3A%20https%3A%2F%2Fnccd.cdc.gov%2FCKD%2FDocuments%2FCKD_FactSheet_2023.pdf%0AVisible%3A%200%25%20

ANNEXES


Number of Cases by Ethnicity
Count
0
5
10
15
20
25
30
35
WHITE
BLACK/AFRICAN AMERICAN
HISPANIC OR LATINO
ASIAN
UNABLE TO OBTAIN
NATIVE AMERICAN
OTHER
Ethnicity


Box Plot of Age
Age
40
50
60
70
80
90


Box Plot of First BUN Levels
First BUN
Box Plot of Mean BUN Levels
Mean BUN
Box Plot of Max BUN Levels
Max BUN
Box Plot of First Creatinine Levels
First Creatinine
Box Plot of Mean Creatinine Levels
Mean Creatinine
Box Plot of Max Creatinine Levels
Max Creatinine
Box Plot of First Heart Rate Levels
First Heart Rate
Box Plot of Mean Heart Rate Levels
Mean Heart Rate
Box Plot of Max Heart Rate Levels
Max Heart Rate


Age vs First BUN
First BUN
Age
status
Alive
Dead
Age vs Mean BUN
Mean BUN
Age vs Max BUN
Max BUN
Age vs First Creatinine
First Creatinine
Age vs Mean Creatinine
Mean Creatinine
Age vs Max Creatinine
Max Creatinine
Age vs First Heart Rate
First Heart Rate
Age vs Mean Heart Rate
Mean Heart Rate
Age vs Max Heart Rate
Max Heart Rate