Heart Failure Mortality Prediction

By:

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Data

- Faisalabad Institute of Cardiology and at the Allied Hospital in Faisalabad (Punjab, Pakistan)
- April-Dec 2015
- 299 Patients in the sample.

- **Machine learning can predict survival of patients with heart failure from serum creatinine and ejection fraction alone**
  - Davide Chicco & Giuseppe Jurman

https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-020-1023-5

Data: Patient's EMR

- Age
- Sex
- Anemia
- Hypertension
- Diabetes
- Smoking Hx
- Ejection Fraction(EF)
- Creatine Phosphokinase
- Serum Creatinine
- Serum Sodium
- Death Event

Sex and Age Distribution: Deaths

Deaths:

F- 34

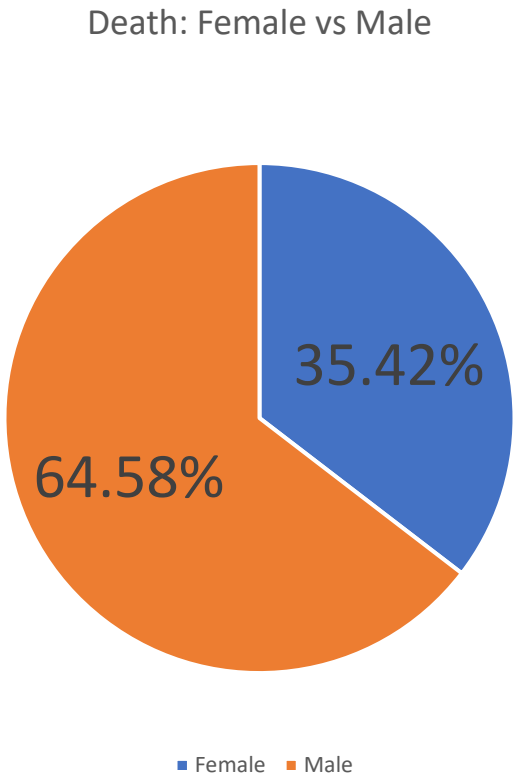
M- 62

Avg Age- 65yo

Median Age- 65yo

Total Deaths: 96

32% of 299 People died.



Sex and Age Distribution: Survival

Survival:

F- 71

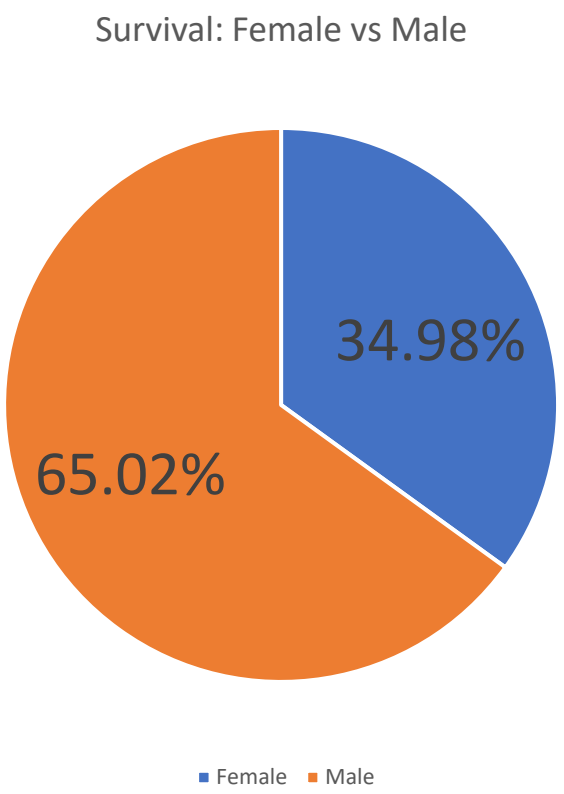
M- 132

Avg Age- 59yo

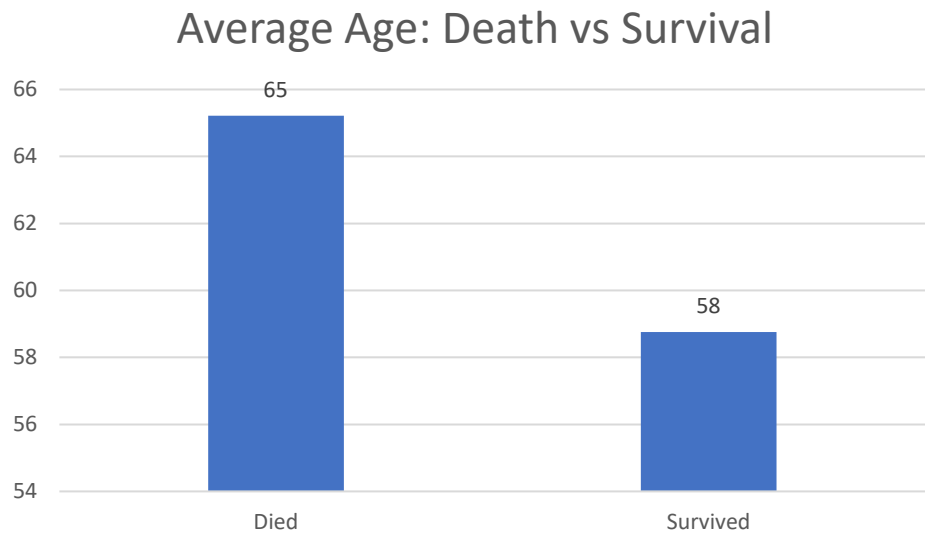
Median- 60yo

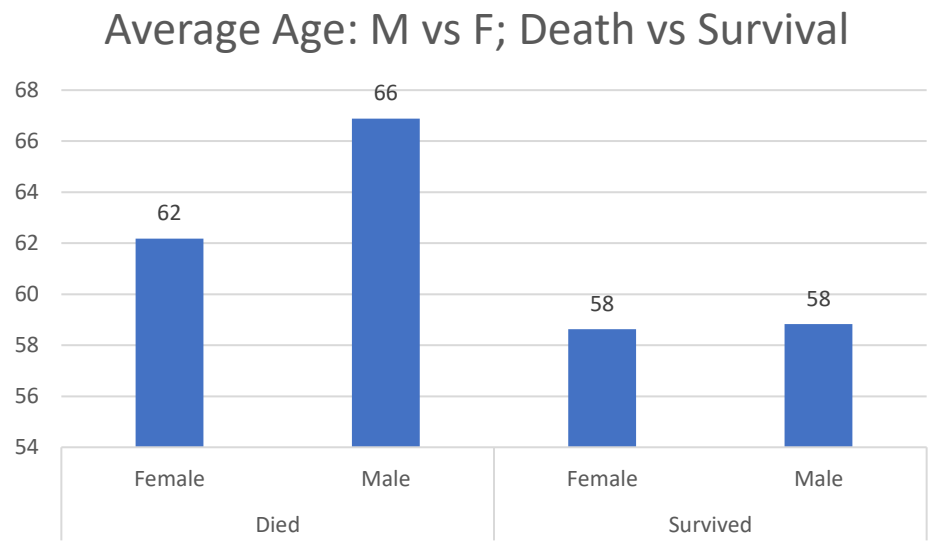
Total Survived: 203

68% of 299 People Survived



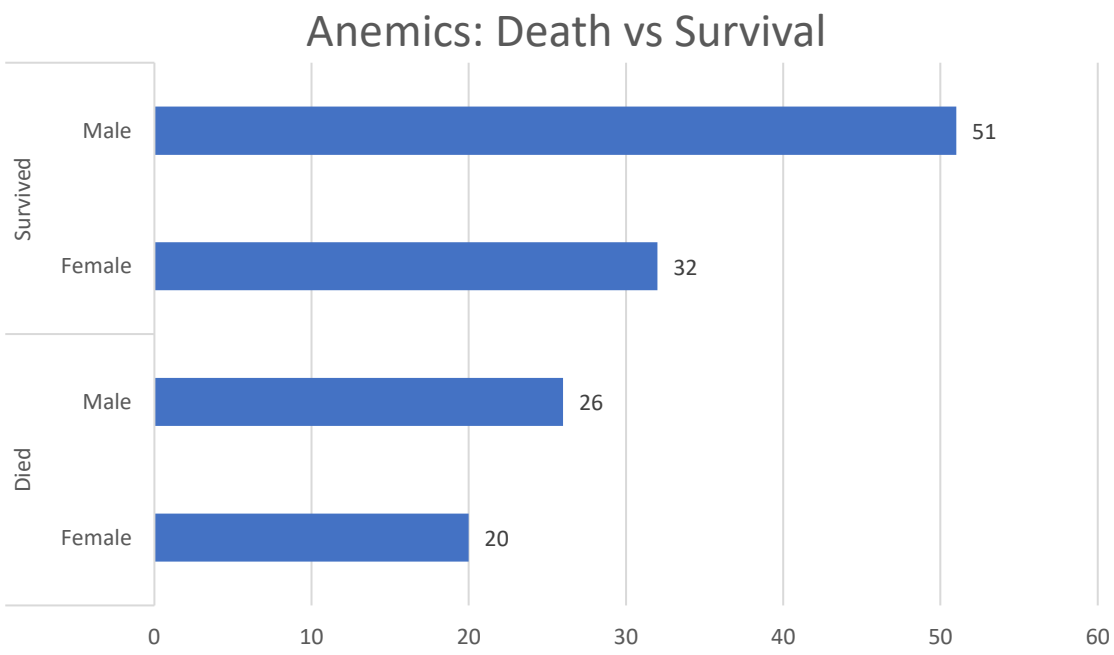
-Heart failure death is more likely to occur >60 year olds

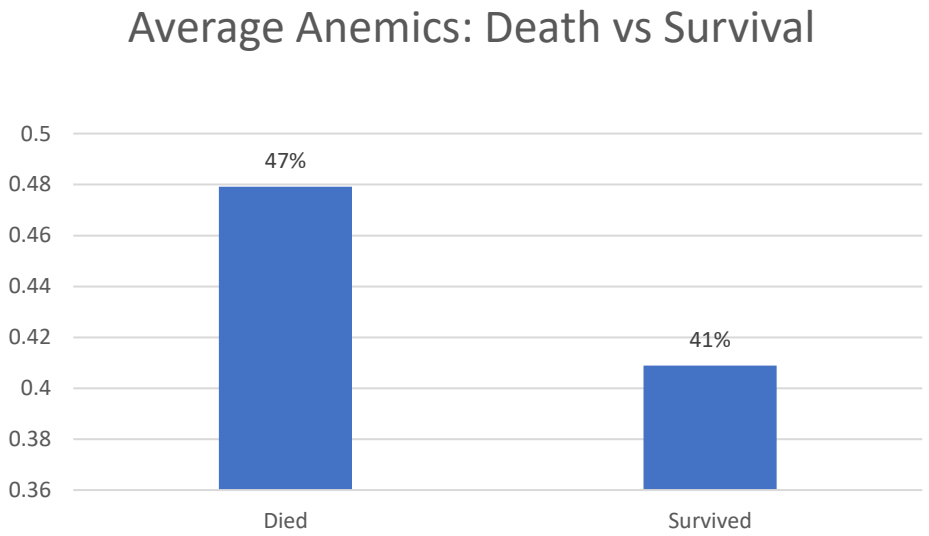




Anemia- Decrease of red blood cells or hemoglobin= Less O2 supply to the heart.

- Death: 46 people; 47%
- Survived: 83 People; 41%

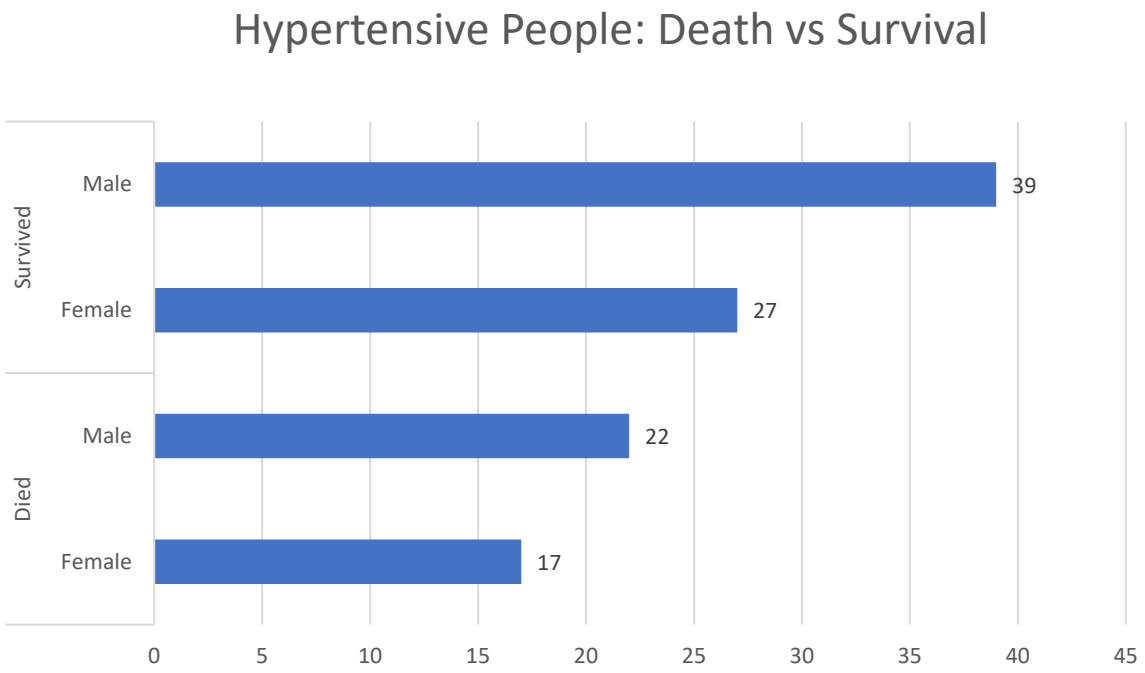


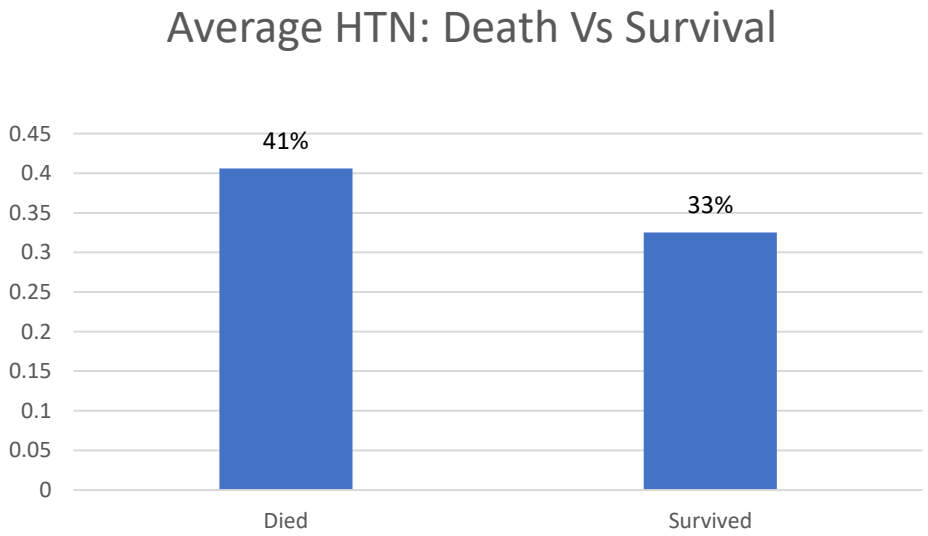


Total Deaths: 96
Total Survived: 203

Hypertension- Damages your arteries by making them less elastic, which decreases the flow of blood and oxygen to your heart and leads to heart disease

- Death: 39 People; 41%
- Survival: 66 People; 33%

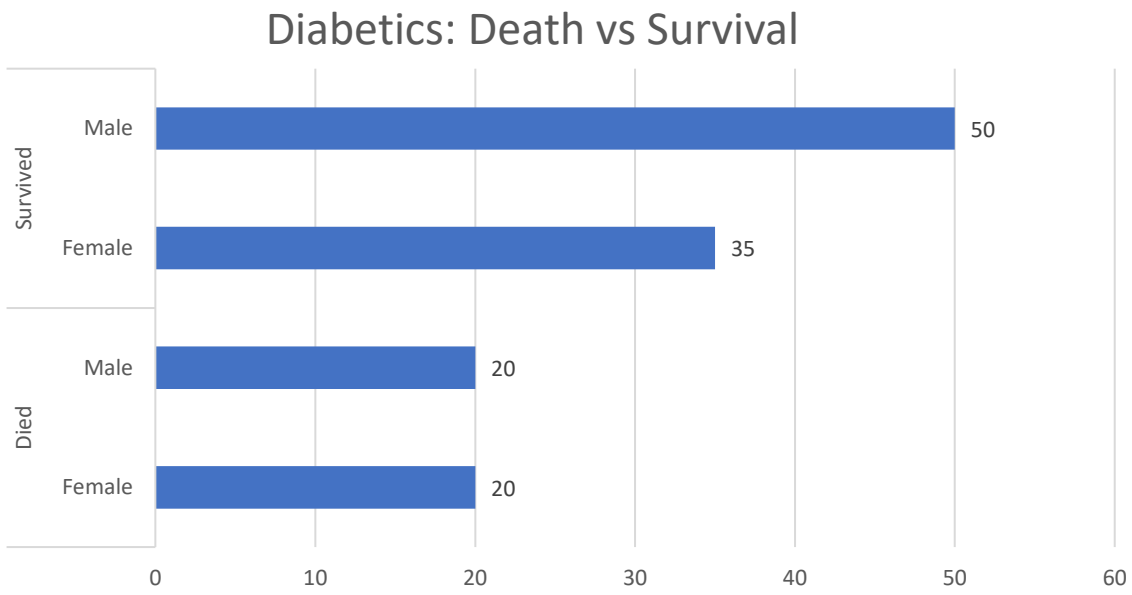


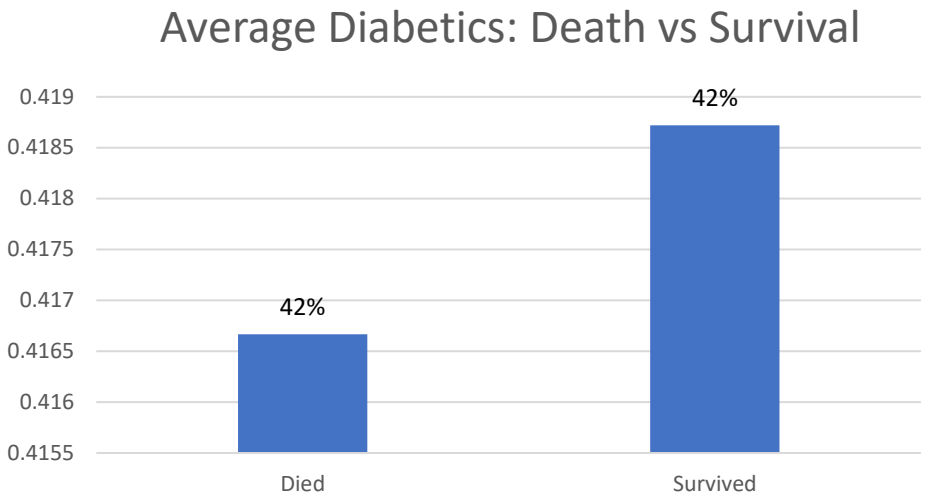


Total Deaths: 96
Total Survived: 203

Diabetes- High blood glucose from diabetes can damage your blood vessels and the nerves that control your heart and blood vessels.

- Death: 40 people; 42%
- Survival: 85 People; 42%



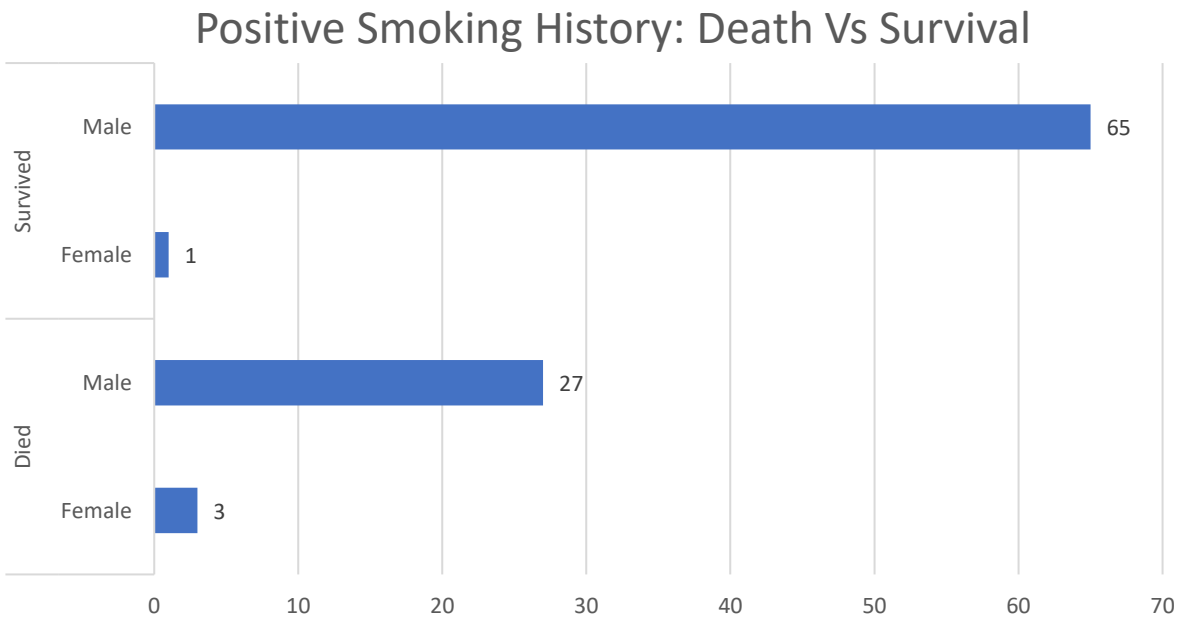


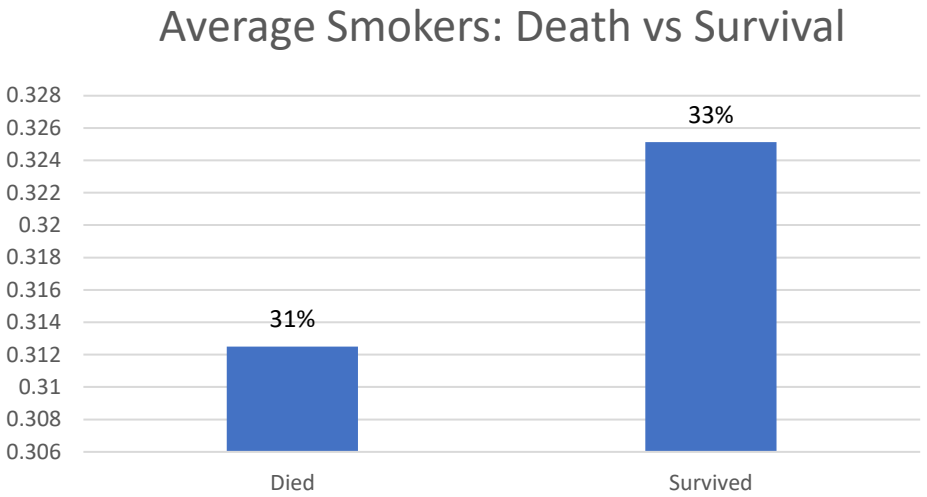
Possible factors contradicting classical assumptions:
-Time span of having diabetes and keeping it under control.

Total Deaths: 96
Total Survived: 203

Positive Smoking Hx- Chemicals in cigarette smoke cause the blood to thicken and form clots inside veins and arteries.

- Death: 30 people; 31%
- Survival: 66 People; 33%



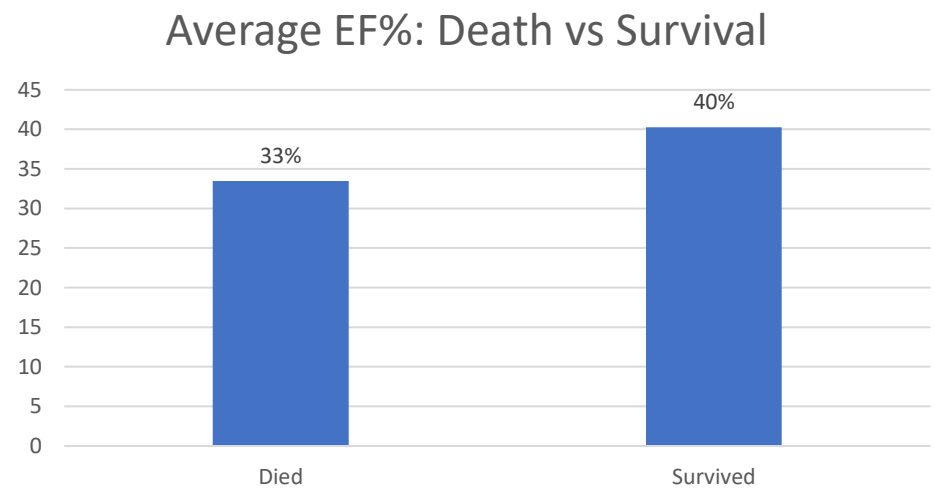


Possible factors contradicting classical assumptions:
-Frequency and span of smoking.

Total Deaths: 96
Total Survived: 203

Ejection Fraction: Percentage of blood leaving the heart to the body

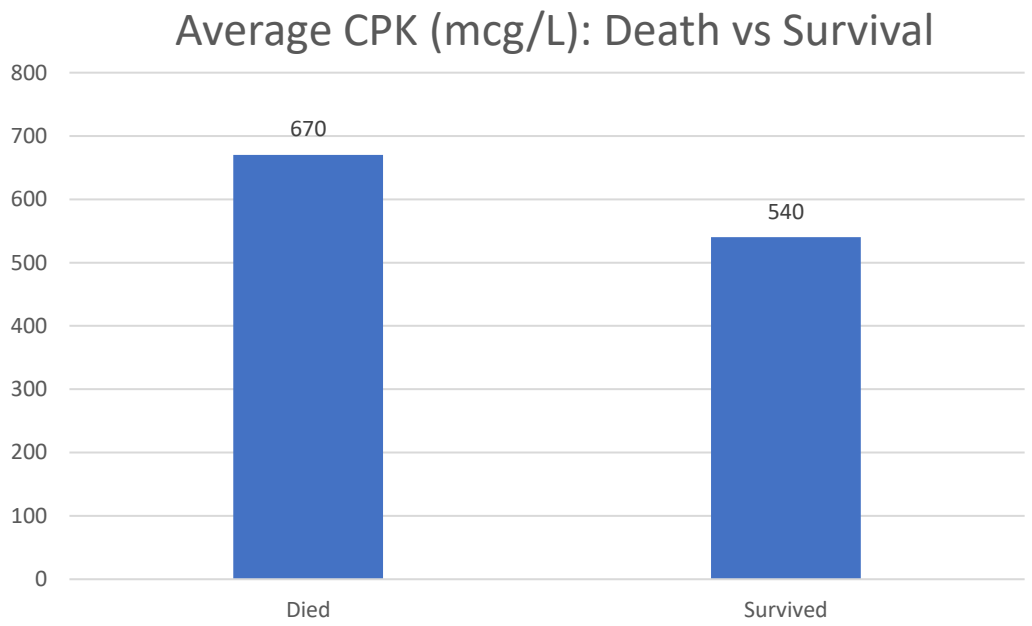
- Normal EF- 50-70%
- Avg EF Survived: 40%
- Avg EF Death: 33%



EF<40% = higher chance of dying from heart failure.

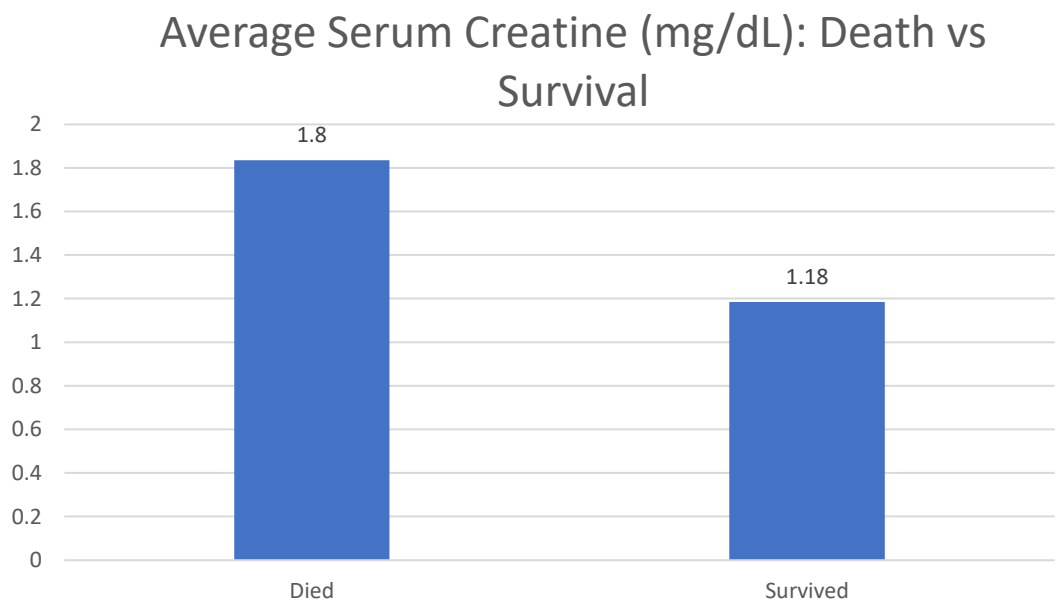
Creatine phosphokinase: Enzyme. When the total CPK level is very high, it most often means there has been injury or stress to muscle tissue, the heart, or the brain

- Normal: 10 to 120 micrograms per liter (mcg/L)
- Although all the values were above the normal range; People who died had higher values than survival. Also, CPK could be high due to other tissue damage.
- Avg CPK Death: 670 mcg/L
- Ave CPK Survival: 540 mcg/L



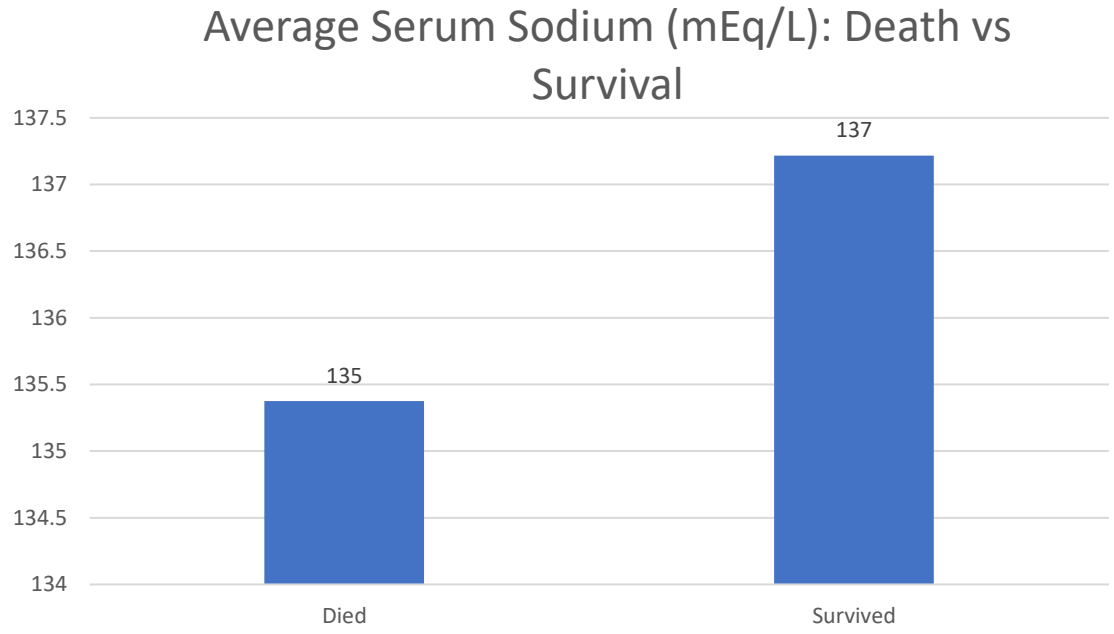
Serum Creatinine: Levels indicative of renal insufficiency owing to chronic reductions of renal blood flow from reduced cardiac output

- Normal Range: 0.74 to 1.35 mg/dL
- Death events = Higher Serum Creatinine
- Avg Death SC: 1.8 mg/dL
- Avg Survival SC: 1.18 mg/dL



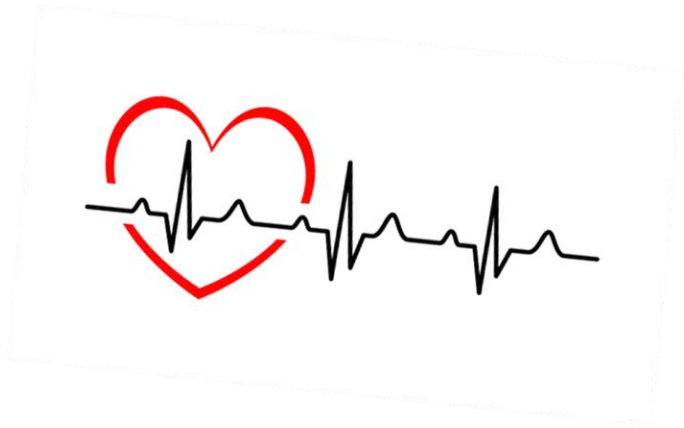
Serum Sodium: Low sodium lvls caused by the hormone Arginine vasopressin (AVP) which increases free-water reabsorption in the renal collecting ducts, increasing blood volume and diluting plasma sodium concentrations. AVP LVLs increase with heart failure

- Normal Range: 135 and 145 (mEq/L)
- Avg SS Death: 135 mEq/L
- Avg SS Survival: 137 mEq/L



Summary

- Heart failure death is more likely to occur >60 year olds
- Men are higher risk than women.
- Excellent and reliable qualifiers to predict heart failure mortality:
  - EF, Serum Creatinine
- Good qualifiers:
  - Age, Serum Sodium, HTN, Anemia, Sex, CPK
- Decent qualifiers:
  - Positive Smoking History, Diabetes



Summary and Data

Row Labels	Count of age	Average of age	Sum of anaemia	Average of anaemia	Sum of high_blood_pressure	Average of high_blood_pressure	Sum of diabetes	Average of diabetes	Sum of smoking	Average of smoking	Average of ejection_fraction
Died	**96**	**65.21528125**	**46**	**0.479166667**	**39**	**0.40625**	**40**	**0.416666667**	**30**	**0.3125**	**33.46875**
Female	34	62.17647059	20	0.588235294	17	0.5	20	0.588235294	3	0.088235294	37.52941176
Male	62	66.88172581	26	0.419354839	22	0.35483871	20	0.322580645	27	0.435483871	31.24193548
Survived	**203**	**58.7619064**	**83**	**0.408866995**	**66**	**0.325123153**	**85**	**0.418719212**	**66**	**0.325123153**	**40.26600985**
Female	71	58.62911268	32	0.450704225	27	0.38028169	35	0.492957746	1	0.014084507	41.87323944
Male	132	58.83333333	51	0.386363636	39	0.295454545	50	0.378787879	65	0.492424242	39.40151515
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Grand Total	**299**	**60.83389298**	**129**	**0.431438127**	**105**	**0.351170569**	**125**	**0.418060201**	**96**	**0.321070234**	**38.08361204**

Summary and Data

Row Labels	Average of creatinine_phosphokinase	Average of serum_creatinine	Average of serum_sodium
Died	**670.1979167**	**1.835833333**	**135.375**
Female	507.6764706	1.945882353	135.4705882
Male	759.3225806	1.775483871	135.3225806
Survived	**540.0541872**	**1.184876847**	**137.2167488**
Female	461.9859155	1.115070423	137.4225352
Male	582.0454545	1.222424242	137.1060606
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Grand Total	**581.8394649**	**1.393879599**	**136.6254181**