



Survival of Pediatric Cancer Patients

By Teresa Cameron

Pediatric Cancer Overview



Cancer is the 2nd
commonest cause of
death in children in the
developed countries.

15,780

Estimated children are
diagnosed with cancer
in the U.S. each year

38,000

Childhood malignant cancer
deaths were averted in the U.S.
from 1975 to 2006 as a result
of more effective treatments

50%

**Decrease in all malignant childhood
cancers mortality rates between 1975
and 2006**



263 variables

Including patient demographics, tumor morphology, extent of disease, treatments, and survival data.

SEER Program

The SEER (Surveillance, Epidemiology, and End Results) Program began in 1973 and provides information on cancer statistics to help reduce the cancer burden among the U.S. population.

SEER collects and publishes cancer incidence and survival data from population-based registries covering approximately 48% of the U.S. population.

Geographic Information Systems

Portal with interactive mapping and visualization of cancer-related geospatial data

Cancer Statistics Review (CSR)

Annual report of most recent cancer incidence, mortality, survival, prevalence, and lifetime risk statistics

Pediatric Cancer Data

Patients



69,263

0 – 17 year old

Years



2000 - 2018

Variables

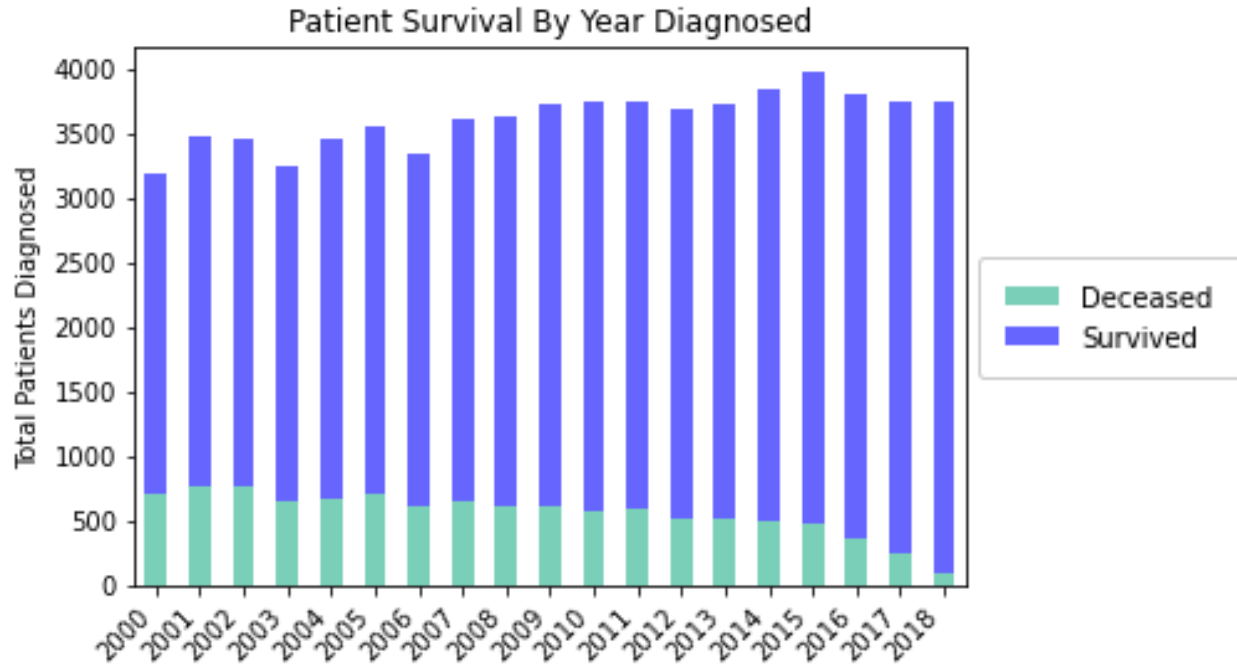


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Age, Gender, Year
Diagnosed, Race, Site,
Median Household Income,
Rural-Urban Code, Survival
Months, Cause of Death

Patient Survival by Year

Bar Graph

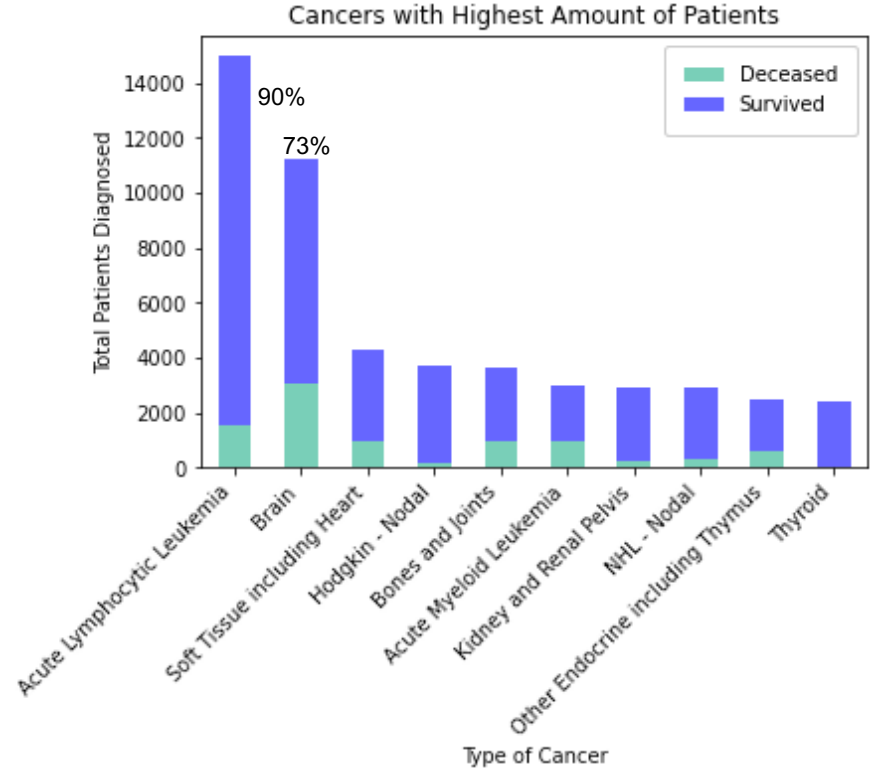


Table

| | Deceased | Survived |
|------|----------|----------|
| 2000 | 22.26% | 77.74% |
| 2001 | 21.90% | 78.10% |
| 2002 | 22.35% | 77.65% |
| 2003 | 20.03% | 79.97% |
| 2004 | 19.16% | 80.84% |
| 2005 | 20.10% | 79.90% |
| 2006 | 18.07% | 81.93% |
| 2007 | 18.07% | 81.93% |
| 2008 | 17.14% | 82.86% |
| 2009 | 16.33% | 83.67% |
| 2010 | 15.19% | 84.81% |
| 2011 | 15.74% | 84.26% |
| 2012 | 14.10% | 85.90% |
| 2013 | 14.14% | 85.86% |
| 2014 | 12.90% | 87.10% |
| 2015 | 11.86% | 88.14% |
| 2016 | 9.74% | 90.26% |
| 2017 | 6.61% | 93.39% |
| 2018 | 2.80% | 97.20% |

Patient Survival by Cancer Type

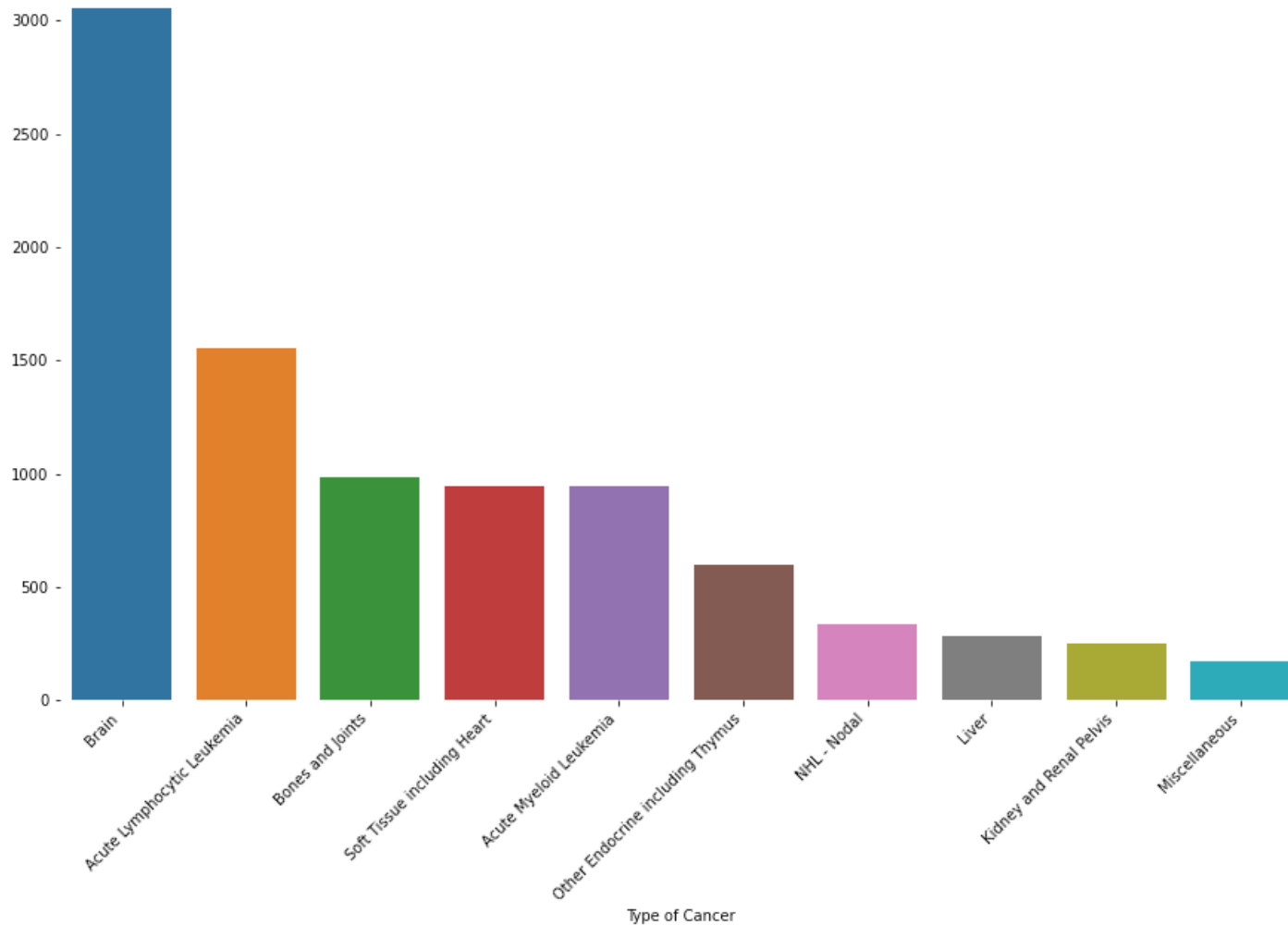
Bar Graph



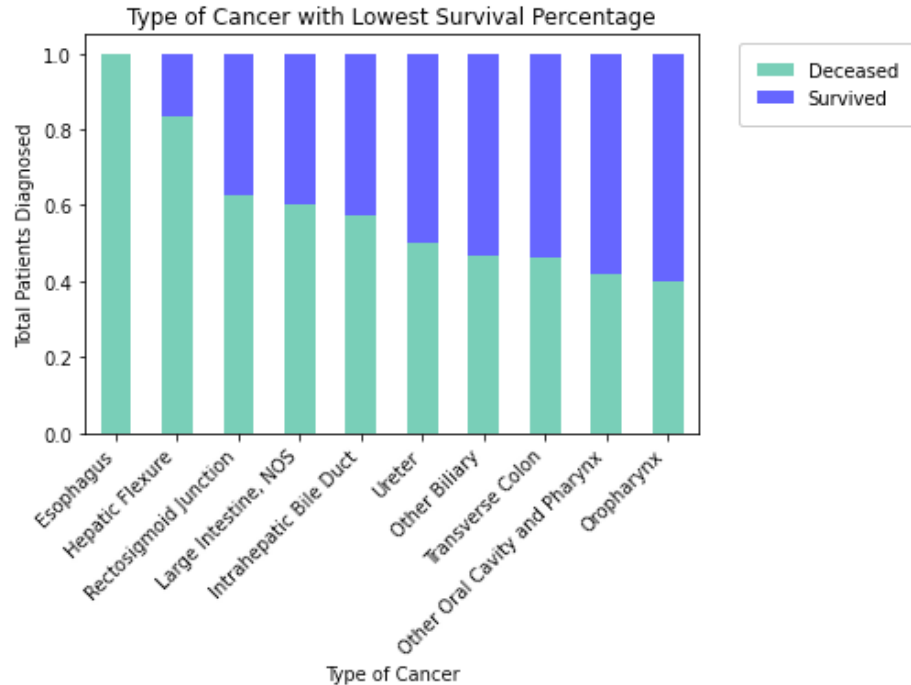
Table

| | Deceased | Survived |
|----------------------------------|----------|----------|
| Acute Lymphocytic Leukemia | 1556 | 13406 |
| Brain | 3051 | 8205 |
| Soft Tissue including Heart | 945 | 3331 |
| Hodgkin - Nodal | 131 | 3544 |
| Bones and Joints | 987 | 2613 |
| Acute Myeloid Leukemia | 942 | 2050 |
| Kidney and Renal Pelvis | 250 | 2671 |
| NHL - Nodal | 336 | 2573 |
| Other Endocrine including Thymus | 600 | 1852 |
| Thyroid | 14 | 2364 |

Total Deaths from 2000 to 2018 by Cancer Type



Bar Graph

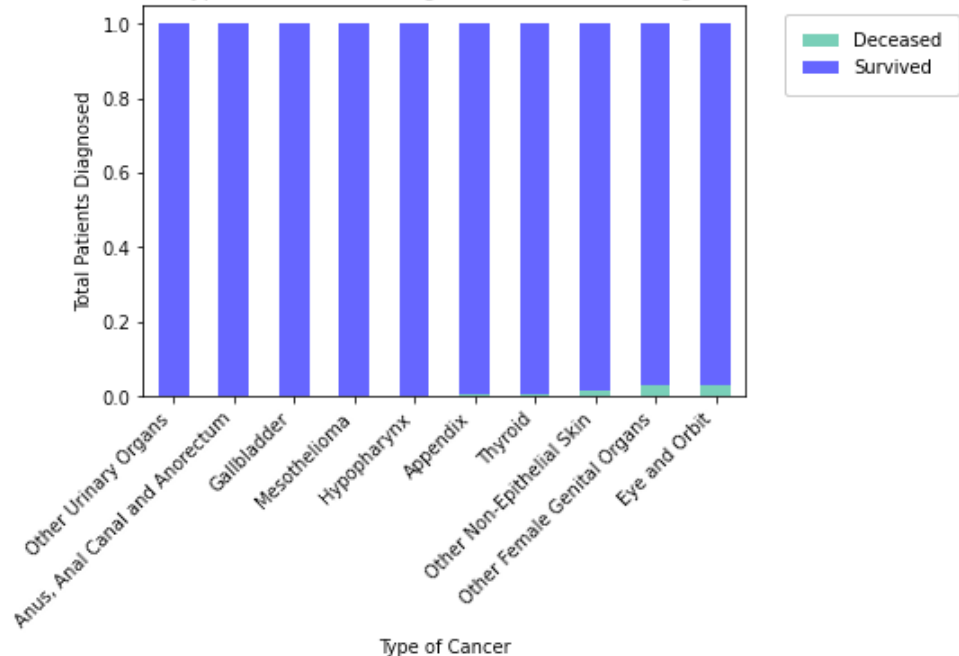


Table

| | Deceased | Survived |
|-------------------------------|----------|----------|
| Esophagus | 100.00% | 0.00% |
| Hepatic Flexure | 83.33% | 16.67% |
| Rectosigmoid Junction | 62.50% | 37.50% |
| Large Intestine, NOS | 60.00% | 40.00% |
| Intrahepatic Bile Duct | 57.14% | 42.86% |
| Ureter | 50.00% | 50.00% |
| Other Biliary | 46.67% | 53.33% |
| Transverse Colon | 46.15% | 53.85% |
| Other Oral Cavity and Pharynx | 41.67% | 58.33% |
| Oropharynx | 40.00% | 60.00% |

Bar Graph

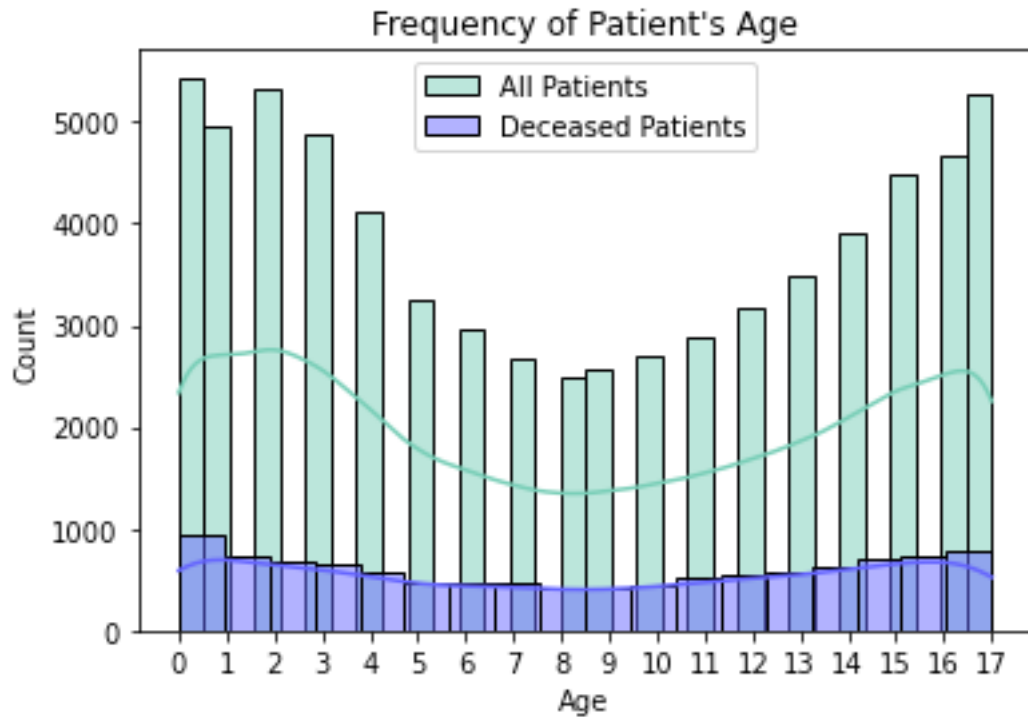
Type of Cancer with Highest Survival Percentage



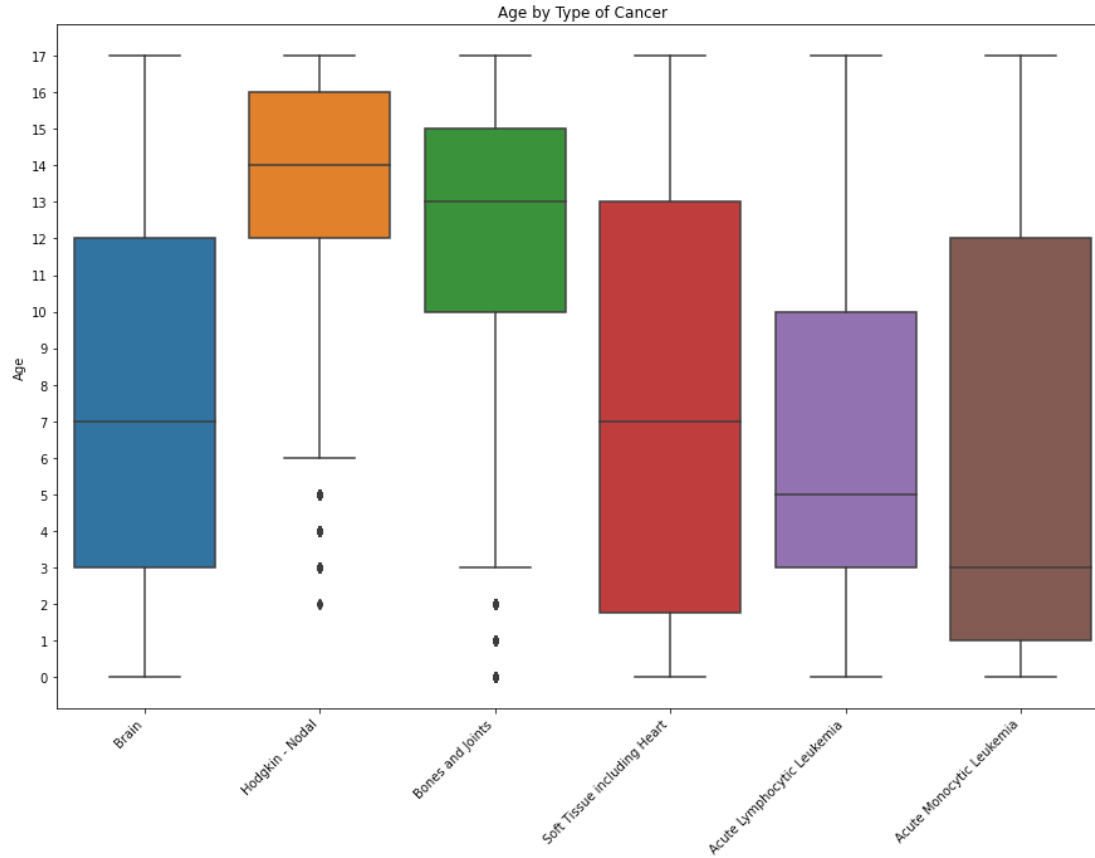
Table

| | Deceased | Survived |
|--------------------------------|----------|----------|
| Other Urinary Organs | 0.00% | 100.00% |
| Anus, Anal Canal and Anorectum | 0.00% | 100.00% |
| Gallbladder | 0.00% | 100.00% |
| Mesothelioma | 0.00% | 100.00% |
| Hypopharynx | 0.00% | 100.00% |
| Appendix | 0.43% | 99.57% |
| Thyroid | 0.59% | 99.41% |
| Other Non-Epithelial Skin | 1.43% | 98.57% |
| Other Female Genital Organs | 2.86% | 97.14% |
| Eye and Orbit | 2.97% | 97.03% |

Distribution of Patient's Age

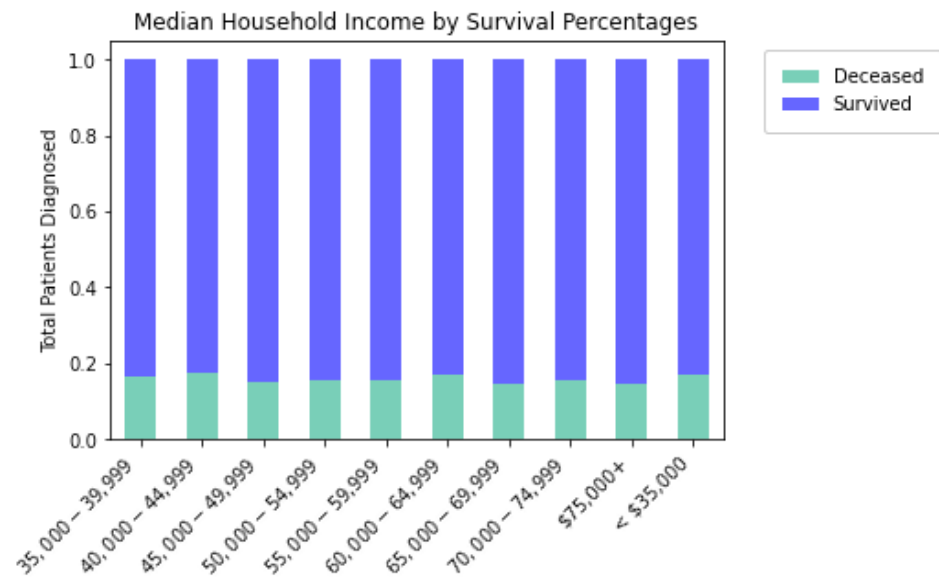


Distribution of Patient's Age by Type of Cancer



Patient Survival by County's Median Household Income

Bar Graph

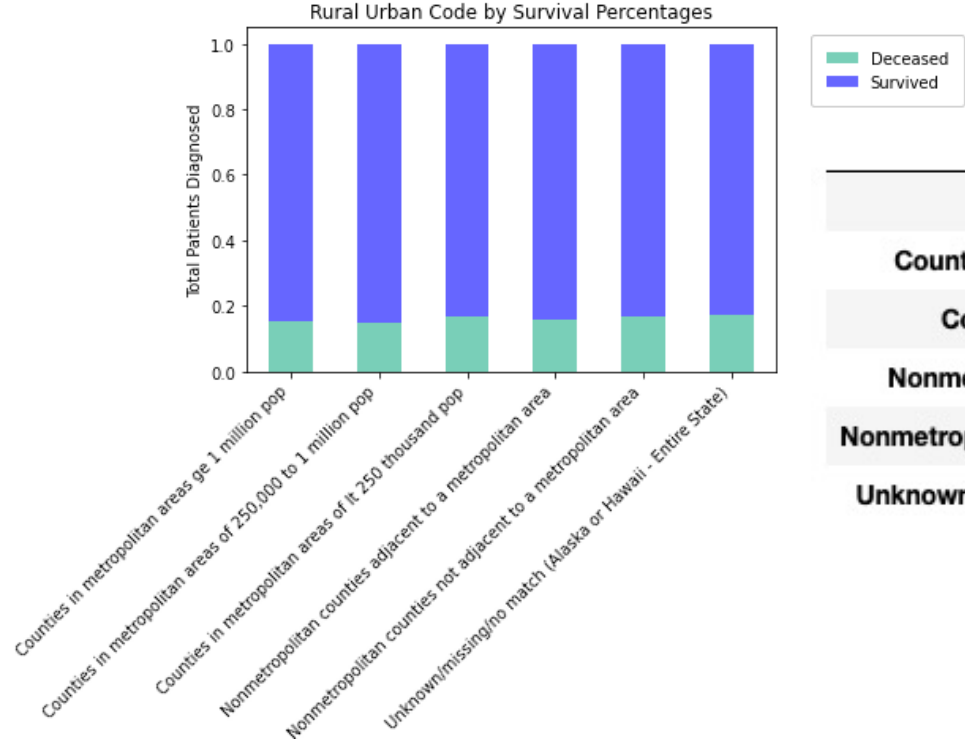


Table

| | Deceased | Survived |
|------------------|----------|----------|
| 35, 000 – 39,999 | 16.74% | 83.26% |
| 40, 000 – 44,999 | 17.40% | 82.60% |
| 45, 000 – 49,999 | 15.05% | 84.95% |
| 50, 000 – 54,999 | 15.71% | 84.29% |
| 55, 000 – 59,999 | 15.30% | 84.70% |
| 60, 000 – 64,999 | 17.20% | 82.80% |
| 65, 000 – 69,999 | 14.64% | 85.36% |
| 70, 000 – 74,999 | 15.63% | 84.37% |
| \$75,000+ | 14.66% | 85.34% |
| < \$35,000 | 16.95% | 83.05% |

Patient Survival by County's Population

Bar Graph



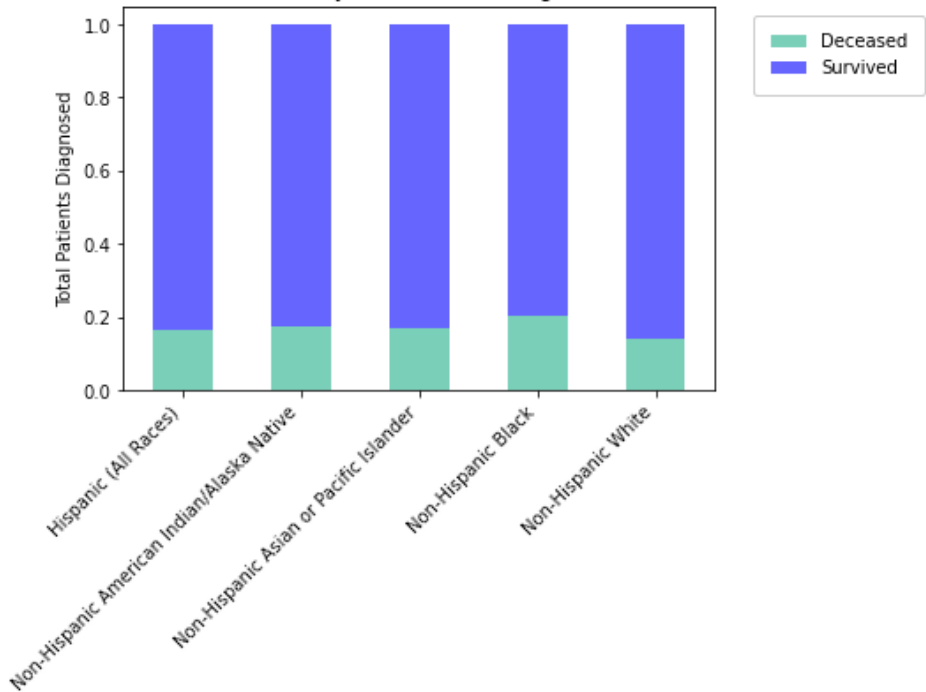
Table

| | Deceased | Survived |
|--|----------|----------|
| Counties in metropolitan areas ge 1 million pop | 15.46% | 84.54% |
| Counties in metropolitan areas of 250,000 to 1 million pop | 14.99% | 85.01% |
| Counties in metropolitan areas of lt 250 thousand pop | 16.64% | 83.36% |
| Nonmetropolitan counties adjacent to a metropolitan area | 15.77% | 84.23% |
| Nonmetropolitan counties not adjacent to a metropolitan area | 16.62% | 83.38% |
| Unknown/missing/no match (Alaska or Hawaii - Entire State) | 17.07% | 82.93% |

Patient Survival by Race

Bar Graph

Race by Survival Percentages



Table

| | Deceased | Survived |
|--|----------|----------|
| Hispanic (All Races) | 16.48% | 83.52% |
| Non-Hispanic American Indian/Alaska Native | 17.44% | 82.56% |
| Non-Hispanic Asian or Pacific Islander | 16.89% | 83.11% |
| Non-Hispanic Black | 20.45% | 79.55% |
| Non-Hispanic White | 13.90% | 86.10% |

Z-Test to Determine Statistical Significance

01

Sample

Select a sample of data for each race variable.

Null Hypothesis: The race of patients does not have an effect on survival rate.

02

Normal Distribution

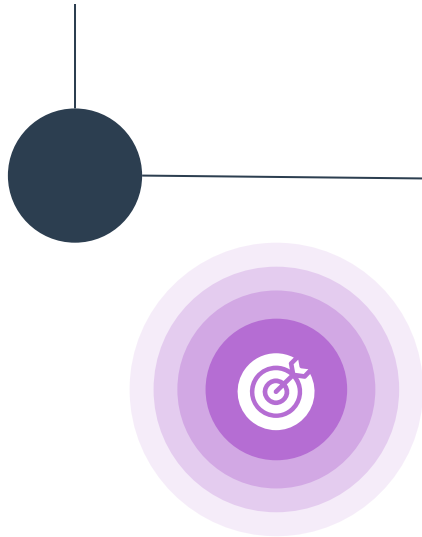
Check the samples are approximately normally distributed.

Alternative Hypothesis: The race of patients affected their survival rate.

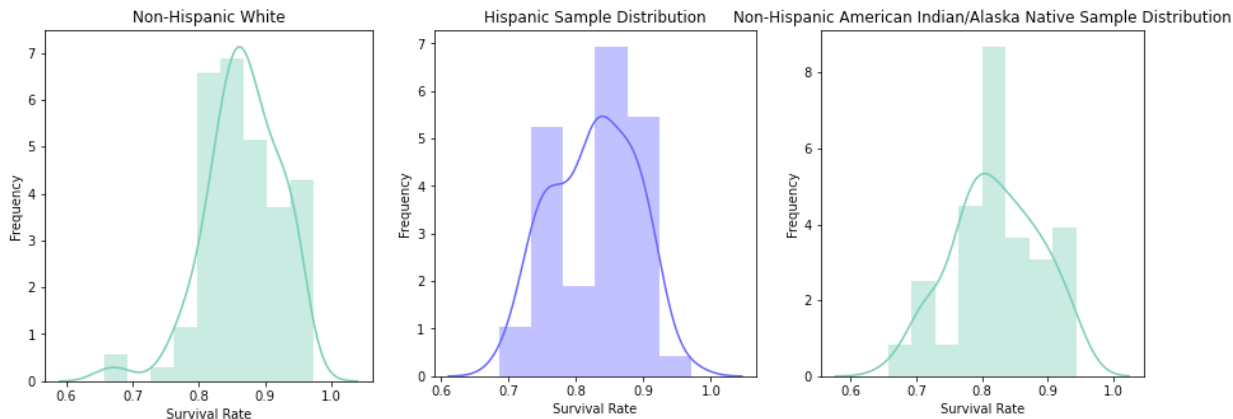
03

Z-score and P-value

Compares the means of each sample to each other.

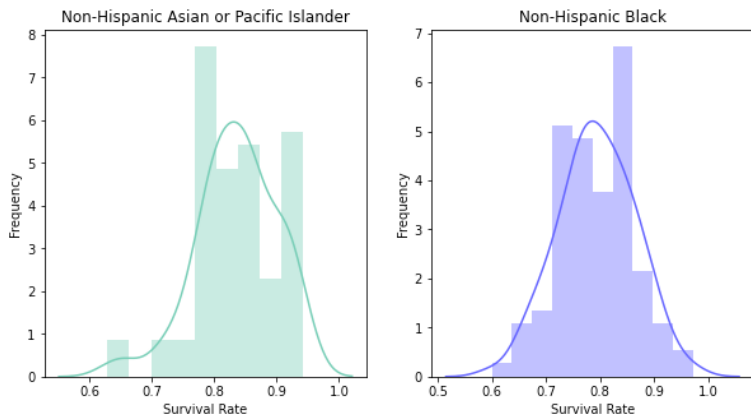


Distribution of Survival Rate from Sample



Means of Samples

87% Non-Hispanic White
83% Hispanic
82% American Indian/Alaska Native



Means of Samples

84% Asian or Pacific Islander
79% Non-Hispanic Black

Z-Score and P-Value

01

Z-Score

Measures how many standard deviations a value is from the mean.

02

P-Value 0.05

Probability that the measured effect is due to randomness.

Non-Hispanic Black

Z-Score : 8.08
P-Value: 6.40e-16

Hispanic

Z-Score : 4.79
P-Value: 1.65e-06

American Indian Alaskan Native

Z-Score: 5.21
P-Value: 1.89e-07

Asian and Pacific Islander

Z-Score : 3.53
P-Value: 0.00041

We can reject the null hypothesis and accept the alternative hypothesis that the race of patients affected their survival rate.

What Does This Mean?

The conclusion is that the means from the random sample proves a significant correlation between race of patient and survival rate. We still cannot establish causation between these features, and this also does not indicate a correlation in the population.

Next steps for this analysis would be to examine additional variables such as treatment or types of cancers to see if we can find other variables that could contribute to this disparity.

Thank you!