I, Tawanna Childs, hereby submit this original work as part of the requirements for the degree of Master of Science in Biostatistics (Environmental Health).

It is entitled:
Trend Analysis of Hospital Admission for Pediatric Femur Cancer

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Trend Analysis of Hospital Admission for Pediatric Femur Cancer

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By

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Abstract

Primary malignant neoplasm of long bones of the lower limb, or femur cancer is a rare disease among children and adolescents. Thirty years ago the only treatment option available was amputation with a survival rate of only 10 to 20%. Today, amputation is used selectively and only accounts for approximately 6-10% of all primary hip or femur procedures.

In this study, we wanted to assess the demographic trend analysis of hospital admissions for femur cancer, possible risk factors for amputation, and the overall hospital costs for a child with femur cancer based on procedure and severity. The nationwide Healthcare Cost and Utilization Project KIDs’ Inpatient Database, Agency for Healthcare Research and Quality for the years 1997-2012 were utilized for this study. The International Classification of Diseases, Ninth Revision (ICD-9) code 170.7 was used to identify patients with malignant neoplasm of long bones of the lower limb. Data was weighted and missing states were predicted using linear regression for trend analysis and incidence rates. Classification trees analyzed amputation versus no amputation and multivariate regression assessed the cost to charge per day and total charges per day for a child with femur cancer.

Approximately 6.4 per 1,000,000 children and adolescents 18 years and under in the United States are diagnosed each year with some form of femur cancer. Classification trees grouped patients into one of two categories, amputation or no amputation, based on risk factors. The results indicate a child between the ages of 15 to 18 or the number of diagnosis (NDX) greater than 4 will have a higher risk of amputation. The most significant difference in the cost to charge per day for a child with femur cancer was due to age, number of diagnosis (NDX), and insurance. When the cost to charge per day is for complicated discharges only, the most significant variables are amputation and number of diagnoses.
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Table of Contents

Abstract iii
Acknowledgements v
List of Tables vii
List of Figures viii
Introduction 1
Materials and Methods 2

Results
i. Trend Study 8
ii. Classification 20
iii. Incidence Rate of Femur Cancer Cases 30
iv. Basket Analysis 34
v. Multiple Regression of Total Charges 35

Discussion 36
Future Implications 37
Tables 38
Appendix 1: SAS Code 68
Appendix 2: R Code 115
List of Tables

Table 1: International Classification of Diseases, Ninth Revision Procedure Codes

Table 2: Imputed Femur Cancer Variables by Year

Table 3: Top 5 Secondary ICD-9 Codes (DX2) Associated with a Primary Diagnosis of Femur Cancer (1997-2012)

Table 4: Top 5 Combined ICD-9 Codes Associated with Primary Femur Cancer

Table 5: Basket Analysis of ICD-9-CM codes associated with Secondary Femur Cancer (1997-2012)

Table 6: Basket Analysis of ICD-9-CM codes associated with Amputation (1997-2012)

Table 7: Multiple Regression of Total Charges Per Day (1997-2012)

Table 8: Multiple Regression of Cost to Charge per Day with Complications (2003-2012)

Table 9: Multiple Regression of Cost to Charge Per Day with No Complications (2003-2012)

Table 10: Multiple Regression of Cost to Charge per Day (2003-2012)

Table 11: Cost to Charge by State
List of Figures

Figure 1: Scatterplot of Pediatric Non-Births Versus Pediatric Population
Figure 2: Scatterplot of Standard Deviation Non-Births Versus Pediatric Population
Figure 3: Pediatric Non-Births (2000-2009)
Figure 4: Primary/ Secondary Femur Cancer (2000-2009)
Figure 5: Primary Femur Cancer Discharges (2000-2009)
Figure 6: Primary Femur Cancer Discharges by Gender (2000-2009)
Figure 7: Primary Femur Cancer Discharges by Age (2000-2009)
Figure 8: Primary Femur Cancer Discharges by Insurance Type (2000-2009)
Figure 9: Primary Procedure of Amputation (2000-2009)
Figure 10: All Primary Femur or Hip Procedure in 1997
Figure 11: All Primary Femur or Hip Procedure in 2000
Figure 12: All Primary Femur or Hip Procedure in 2003
Figure 13: All Primary Femur or Hip Procedure in 2006
Figure 14: All Primary Femur or Hip Procedure in 2009
Figure 15: All Primary Femur or Hip Procedure in 2012
Figure 16: Classification Tree of Amputation/ No Amputation in 1997
Figure 17: Classification Tree of Amputation/ No Amputation in 2000
Figure 18: Classification Tree of Amputation/ No Amputation in 2003
Figure 19: Classification Tree of Amputation/ No Amputation in 2006
Figure 20: Classification Tree of Amputation/ No Amputation in 2009
Figure 21: Classification Tree of Amputation/ No Amputation in 2012
Figure 22: Incidence of Femur Cancer in the United States in 2000
Figure 23: Incidence of Femur Cancer in the United States in 2003
List of Figures

Figure 24: Incidence of Femur Cancer in the United States in 2006

Figure 25: Incidence of Femur Cancer in the United States in 2009
Introduction

Primary malignant bone tumors or sarcomas are rare in children and adolescents in the United States; however it’s also the most common in children between the ages of 10-25 when bone growth is most rapid. \(^1,^3\) Osteosarcoma is the most prevalent non-hematologic malignant tumor that’s highly aggressive and is generally found in the metaphysis of long bones, but can occur in any part of the bone. \(^1,^2\) Ewing’s sarcoma is the second most common type of bone cancer in pediatric patients. Patients usually present with symptoms such as pain in the affected limb for an average of 3-6 months before a diagnosis is made. \(^1\)

Prior to 1970, treatment consisted of trans-amputation with a survival rate of just 10-20%. It was discovered that in 80% of the patients diagnosed with some type of sarcoma, silent pulmonary micrometastases was also present.\(^3\) As more effective cytotoxic chemotherapy agents were discovered to combat pulmonary micrometastases the survival rates increased to 65-75%. As a result, treatment efforts shifted from amputation to limb-salvage in 80% of patients diagnosed.\(^4\) Sarcomas occur more frequently in boys than girls presumably due to the longer growth spurt, and extremely rare before the age of 5.\(^1\)

It is important to understand the demographics and current treatment options available based on the age of the patient as well as other secondary conditions that may complicate limb-sparing treatment options. This in turn may help to improve and or expand treatment options to this particular subgroup. To investigate trends, hospital charges, incidence rates and treatment type over the past 15 years, I will use the KID all-payer inpatient administrative database to access the healthcare records of over 40 million weighted discharges. From this study, I will examine the type of treatment (amputation or limb-salvage) implemented based on risk factors, and total hospital charges per day based on age, gender, complications, number of diagnoses, insurance type and treatment in patients less than or equal to 18 years of age.
Materials and Methods

The information for statistical analysis for the years 1997, 2000, 2003, 2006, 2009, and 2012 were obtained from the KID all-payer inpatient administrative database maintained by AHRQ's Healthcare Cost and Utilization Project (HCUP). The KID is a stratified random sample of participating hospitals within the HCUP sampling frame. The data is based on hospital level discharges from non-Federal short term, community based hospitals in the United States. Hospital level identifiers are removed from the discharge summary by HCUP so hospitalizations cannot be linked to individual patients. The discharge summary includes core data such as demographic information, diagnoses codes, expected payer, hospital charges, etc., and hospital data that contains information such as hospital location, bed-size, and type of hospital. The study design of the KID includes a 10% sample of all normal newborn discharges and 80% of complicated hospital births and 80% of all other pediatric discharges from each hospital.

Patients in the 1997 KID database include pediatric discharges 18 years of age or less. Patients in the 2000, 2003, 2006, 2009, 2012 KID database includes pediatric discharges 20 years or less. Discharges with missing, invalid or inconsistent ages are excluded. The 1997 KID Inpatient Database was collected from 22 states with 2521 participating hospitals and 6,657,326 weighted pediatric discharges. The 2000 database was collected from 27 states, 2784 hospitals with 7,291,032 weighted pediatric discharges. The 2003 database was collected from 36 states, 3438 hospitals with 7,409,162 weighted pediatric discharges. In 2006, data contained information from 38 states, 2263 hospitals with 7,558,812 weighted pediatric discharges. In 2009, data was collected from 38 states, 4121 hospitals with 7,370,203 pediatric discharges. In 2012, data was collected from 44 states, 4179 hospitals with 6,675,222 pediatric discharges. There is a total of 42,961,757 pediatric discharges for all 6 data sets combined.

The target population was a primary diagnosis of femur cancer that includes osteosarcoma, Ewing's sarcoma and secondary malignancies. We used the International Classification of Diseases, Ninth Revision (ICD-9-CM) diagnostic code of (170.7) malignant neoplasm of long
bones of lower limb to identify discharges whose primary diagnosis code was femur cancer and less than or equal to 18 years old.\textsuperscript{22} Nineteen and twenty year olds were not included in order to remain consistent with the 1997 data set.\textsuperscript{12} To identify femur cancer discharges categorized as having some type of femur or hip procedure the following Diagnosis Related Group (DRG) codes are utilized: 210 (hip and femur procedures except major joint with complications, comorbidities (CC)), 211 (hip and femur procedures except major joint without complications, comorbidities (CC)), 212 (hip and femur procedures except major joint), 213 (Amputation for musculoskeletal system and connective tissue disorders), 235 (fractures of femur), and 236 (Fractures of Hip and Pelvis) for the years 1997-2006.\textsuperscript{22} For the data sets 2009 and 2012 the DRG codes are DRG 480 (hip and femur procedures except major joint with major complications and comorbidities (MCC)), 481 (hip and femur procedures except major joint with CC), 482 (hip and femur procedures except major joint without CC/MCC), 533 (fractures of femur with major CC), and 534 (fractures of femur without MCC), 474 (Amputation for musculoskeletal system and connective tissue disorders with MCC), 475 (Amputation for musculoskeletal system and connective tissue disorders with CC), 476 (Amputation for musculoskeletal system and connective tissue disorders without CC/MCC).\textsuperscript{22} From the DRG codes, the binary outcome of interest from the target population of femur cancer, amputation versus no amputation, were identified using the ICD-9-CM procedure codes and previous studies and is summarized in Table 1.\textsuperscript{3,22}

The KID is a two-step stratified study that does not involve sampling hospitals instead the KID includes a sample of pediatric discharges from all participating HCUP partner states. The discharges are systematically randomly sampled to select 10% uncomplicated in-hospital births, 80% complicated in-hospital births and 80% all other pediatric non-births from each hospital.\textsuperscript{10,23} Discharges are then post-stratified on six characteristics

Geographic region-Northeast, Midwest, West and South

Hospital control - Public, private, voluntary
Location and Teaching Status – Teaching and urban, non-teaching and urban, or rural
Bed-size – Small, medium, large
Hospital type – Freestanding Children’s Hospital or other \(^{10,23}\)

The large sample size and study design allows for the study of rare diseases such as femur cancer. \(^{10}\)

A discharge weight (supplied by HCUP) is applied by stratum in proportion to the number of AHA non-newborns to non-newborn discharges. Discharge weights are constant for all discharges of the same type within a stratum except for hospitals in a stratum that are open for the entire year but contribute less than an entire years data. In this study, we are only concerned with pediatric non-births. The discharge weight \((W_k)\) equation for the non-newborn strata is

\[
W_{ik} = \left[ \frac{T_k}{R_k \times A_k} \right] \times (4 + Qi)^{11}
\]

Where \(k\) represents the stratum and \(i\) represents the hospital

- \(T_k\) is the total number of non-newborn births reported in the American Hospital Association survey (AHA) in stratum \(k\) (The total number of discharges and births for every hospital in the AHA universe can be obtained from HCUP) \(^{11}\)
- \(A_k\) total number of adjusted non-newborn discharges in stratum \(k\) \(^{11}\)
- \(R_k\) has the following equation: \(R_k = S_k / H_k\) where \(S_k\) is the number of adjusted discharges sampled for the discharge type (complicated newborns and other) in stratum \(k\) and \(H_k\) is the total number of adjusted discharges in the sampling frame for the discharge type (complicated newborns and other) of stratum \(k\). \(R_k\) is approximately 80%. \(^{11}\)
- \(Qi\) is the number of quarters that a hospital contributes discharge data. If a hospital that has been opened for the entire year but only contributes data for two quarters then the data is doubled. \(^{11}\)
The KID is discharge level and not patient level records so a child may be admitted to the hospital multiple times in a year. As a result their age, insurance type, diagnosis code etc. may change. For this reason we are primarily investigating discharges that are admitted to the hospital with a primary diagnosis code (DX1) of femur cancer and a primary procedure code (PR1) of hip or femur procedure to study amputation versus no amputation. This helps to target patients who are having a procedure for the first time and eliminate ones who are there for complications from a previous procedure possibly coded as PR2 (secondary procedure) and femur cancer patients coded as DX2 (secondary diagnosis) who may be there for follow-up care or complications that may be related to femur cancer. To handle missing values within a data set multiple imputations is performed on all years.

Missing values in the KID HCUP data set are due to HCUP state partners or hospitals that do not supply the information, missed or invalid recording. These missing values can compromise the quality of a study if the discharges with missing values are different from the discharges with valid values. In these types of cases the estimates may produce a bias. In SAS, missing values, by default, are deleted which is one method to handle such data if the percentage of missing values is very small or the missing population is similar to the observed population. Another possible method is the substitution of missing values using the mean of known variables but this does not reflect the uncertainty of unknown missing values, and the values will be biased towards zero.

In this study, multiple imputations was used to address the issue of missing data because each missing value is replaced with a set of m complete data sets which was then analyzed using a regression-based method. The missing data in this study is assumed missing at random (MAR). The missing data depends on the observed values. In this way, we can use the observed values to make inferences about the missing values.

Suppose there is an

\[ N \times p \text{ data matrix } Y = (Y_1, Y_2, \ldots, Y_p)^T \text{ with } p \text{ variables and } N \text{ observations} \]
Where \( Y_j (j=1,\ldots,p) \) is a variable with missing values.

The data set in this study was both monotone and missing at random (MAR) thus the indicator matrix represents a monotone missing pattern of \( Y \).

\[
R_1 = \begin{pmatrix}
1 & 1 & 1 \\
1 & 1 & 0 \\
1 & 1 & 0 \\
1 & 0 & 0
\end{pmatrix}
\]

\( R_{ij} \) is 1 if the value of \( Y_j \) is observed and 0 otherwise. Missing values in one column implies missing values in another column or in other words if \( Y_{i2} \) is missing then it is assumed that \( Y_{i3} \) is missing.\(^{24}\)

The regression model

\[
Y_j = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \quad \text{where } X_1, \ldots, X_k \text{ are covariates obtained from the variables } Y_1, \ldots, Y_{j-1} \text{ and } \beta_1, \ldots, \beta_k \text{ are the parameter estimates.}\(^{25}\)

The regression model is fitted to the observed values of the variable \( Y_j \) and its covariates \( X_1, \ldots, X_k \). The fitted model includes the parameter estimates

\[
\beta' = (\beta'_0, \beta'_1, \ldots, \beta'_k) \quad \text{and covariance matrix } \sigma_j^2 V_j, \quad \text{where } V_j \text{ is the } X'X \text{ inverse matrix from the intercepts and covariates } X_1, \ldots, X_k
\]

The new parameters

\[
\beta^* = (\beta^*_0, \beta^*_1, \ldots, \beta^*_k) \quad \text{and } \sigma^*_j
\]

are from \( \beta' = (\beta'_0, \beta'_1, \ldots, \beta'_k) \) and covariance matrix \( \sigma'_j^2 V_j.\(^{25}\)

The variance becomes

\[
\sigma_j^* 2 = \sigma'_j^2 (n_j-k-1)/g
\]

where \( g \) is a \( \chi^2_{n_j-k-1} \) random variate and \( n \) is the number of observed values for the variable \( Y_j \). The regression coefficient are result from

\[
\beta^* = \beta' + \sigma^*_j V_j Z
\]

The missing values are replaced by

\[
\beta^*_0 + \beta^*_1 X_1 + \beta^*_2 X_2 + \ldots + \beta^*_k X_k + z_i \sigma_j^*
\]
where $z_i$ is a simulated normal deviate and $x_1 \ldots x_k$ are values of the covariate.\textsuperscript{25}

The completed data sets are then combined. This method introduces random error into the process and the repeated imputation allows for approximately unbiased estimates of all parameters. The categorical variables, (RACE, FEMALE and PAY1) were verified to be independent by chi square and the continuous variables (LOS, NDX, TOTCHG, and AGE) are normal right-skewed.

The missing data is imputed 10 times to achieve a relative efficiency between 0.997 and 0.999 for all data sets. The relative efficiency is found by the equation

$$RE = (1/(1+F/M))$$

in which $F$ is the fraction of missing information and $M$ is the number of imputations. Imputing an infinite number of times has a relative efficiency of 1 or fully efficient imputation.\textsuperscript{9}

The mean over all $i=1,2,\ldots,m$ imputed data sets is $\bar{Q} = \frac{1}{m} \sum_{i=1}^{m} \bar{Q}_i$ where $\bar{Q}_i$ is a point estimate from the ith imputed data set, $i=1,2,\ldots,m$.

The mean of the within imputation variance equation is $\bar{U} = \frac{1}{m} \sum_{i=1}^{m} \bar{U}_i$ where $\bar{U}_i$ is the variance estimates from the ith imputed data set, $i=1,2,\ldots,m$.

The between imputation variance equation is $B = \frac{1}{m-1} \sum_{i=1}^{m} (\bar{Q} - \bar{Q})^2$ over all imputations

Finally, the total variance is calculated by the equation $T = \bar{U} + (1+\frac{1}{m}B)$. \textsuperscript{9}

Table 2 shows the missing variables for primary femur cancer by year, and the unimputed value (unimputed), the percentage of missing values (%MISS), the imputed value (Imputed) and their corresponding p-value. Differences in mean were analyzed by t-test. A non-significant p-value suggests that the imputed versus the unimputed will not have a significant impact on the dataset.

Statistical analysis was performed using SAS version 9.4 (SAS institute, Cary, North Carolina) and R Core Team (2013). R: A language and environment for statistical computing. R
Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-Project.org/. The statistical methods used for analysis are provided in the results section.

**Results**

**Trend Analysis**

In this study, we look at trends in femur cancer discharges based on data from 2000-2009 in Figures 3-9, specifically all non-birth discharges, primary femur cancer, amputation, age, insurance type and gender. Certain groups within age and insurance type have cell sizes less than 10 so age is categorized as 0-11, and 12-18 years. For insurance type the categories are split into two main types: public (Medicare and Medicaid), and private including HMO, self-pay, no charge and other.

For trend analysis it was necessary to predict the features of the variables of interest for the missing states (those that are not HCUP partners) in order to produce national estimates. The years 1997 and 2012 are excluded from trend analysis because domain analysis could not be performed by state. Linear regression predicted pediatric non-hospital birth discharges from the missing states using the United States census data ≤18 years old. The independent variable is the pediatric census population (0-18 years of age) and the dependent variables are all complicated discharges, male, female, femur cancer, ages 0-11 years, ages 12-18 years, public insurance, private insurance or amputation. For the trend pediatric non-hospital birth discharges in the KID we used the following equation

$$y = \beta_0 + \beta_1 X_1 + \epsilon$$

where $X_1$ is the known census population by state and $y$ represents pediatric non-hospital birth discharges by state in the data set. $\beta_0$ and $\beta_1$ are parameters to be estimated and $\epsilon$ represents the error. Variables are imputed to account for missing values within each dataset and the HCUP discharge weight is applied to obtain values for $y$. 


Figure 1: Plot of the linear graph of United States Pediatric census population (0-18 Years old) versus HCUP pediatric non-birth discharges.

Changes in trend data were evaluated by multivariate normal distribution where femur cancer was considered as cases and all other non-births are considered as the control group. In the case of amputation, all femur cancer cases that were not amputated are considered as the control group and a child coded with a primary procedure code (PR1) of amputation (found in Table 1) are considered cases. All p-values are determined to be significant at \( \text{Pr} \left( X^2_3 > 7.84 \right) \)

For categorical variables p-value is determined by

\[ p_1 = \text{proportion of discharges with primary femur cancer to all pediatric non-hospital birth discharges in 2000.} \]

\[ p_4 = \text{proportion of discharges with primary femur cancer to all pediatric non-hospital birth discharges in 2009.} \]
\( p = \) proportion of discharges with primary femur cancer to all pediatric non-hospital birth
discharges in all four data sets

by the central limit theorem the binomial distribution can be approximated by the normal
distribution.

\( H_0: \) The proportion of discharges with femur cancer to non-hospital births are equal for each
data set.

\( H_a: \) The proportion of discharges with femur cancer to non-hospital births are not equal for each
data set

\[
u = \left(\frac{p_1 - p}{\sqrt{\frac{p(1-p)}{N}}} \right)^2 + \cdots + \left(\frac{p_4 - p}{\sqrt{\frac{p(1-p)}{N}}} \right)^2 \quad \rightarrow X_3^2
\]

p-value = \( \Pr(X_3^2 \geq u) = \Pr(7.81 > u) \)

If \( \Pr(X_3^2 \leq u) \) then reject \( H_0 \), the proportion of discharges with femur cancer for each data set are
not equal and the overall trend is significantly changing. If \( \Pr(X_3^2 \geq u) \)=then accept \( H_0 \), the
proportion of discharges with femur cancer for each data set are equal and the overall trend is
not significantly changing.
Figure 3: All other pediatric discharges are defined as non-hospital births in children less than or equal to 18 years of age discharged from an AHA hospital. In 2000 there are 3,984,247 discharges and 2,783,264 discharges in 2009, a 30.14% decrease. The overall trend from 2000-2009 is significantly changing \( \Pr(\chi^2 \leq u) = \Pr(7.81 < 5.9E5) \). Error bars, 95% Confidence Intervals.
Figure 4: The weighted frequency of pediatric discharges diagnosed with DX1 or DX2 femur cancer (ICD-9 170.7) from 2000-2009. In 2000, there are 0.18% discharges and in 2009 the percent increases to 0.21%. The overall trend is significantly changing $\Pr(X^2_3 \leq u) = \Pr(7.82 \leq 138.6)$. Error bars, 95% Confidence Intervals. b) The percentage of all other pediatric
discharges to primary/secondary femur cancer. There is an increase from approximately 17% to 21.49% in 2009, due to a decrease in the frequency of discharges from 2000-2009 (Figure 3) but a femur cancer frequency that remains steady from 2000-2009 (Figure 4a).
Figure 5: a) The weighted frequency of primary femur cancer discharges of all pediatric patients in the nation from 2000-2009 with an ICD-9 code of 170.7. Error bars, 95% Confidence Intervals. The overall trend is not significantly changing $Pr(\chi^2_3 \geq u) = Pr(7.82 \geq 2.92)$. b) The percentage of all other pediatric discharges to primary femur cancer.
Figure 6: A) The total weighted frequency of male and female discharges with primary femur cancer from 2000-2009. Error bars, 95% Confidence Intervals. The overall trend is not changing significantly for both males $\Pr(X_3^2 \geq u) = \Pr (7.82 \geq 0.034)$ and females $\Pr(X_3^2 \geq u) = \Pr (7.82 \geq 0.01)$. B) The percentage of gender to primary femur cancer discharges.
Figure 7: a) The overall trend of weighted primary femur cancer patients by the age group 0-14 years $\Pr(X_3^2 \leq u) = \Pr(7.82 \leq 38.43)$ and 15-18 years $\Pr(X_3^2 \leq u) = \Pr(7.82 \leq 38.21)$ from 2000 to 2009 is significantly changing for both age groups. Error bars, 95% Confidence Intervals. b) The percentage of age to primary femur cancer.
Figure 8: a) The overall trend analysis of weighted primary femur cancer patients by type of insurance. Type of insurance is divided into two groups (public, and private). Public insurance is defined as Medicare, or Medicaid; Private insurance is defined as HMOs, self pay, other, or no charge. Error bars, 95% Confidence Intervals. There is a significantly changing trend in
public $\Pr(X_3^2 \leq u) = \Pr(7.82 \leq 29.23)$, and private insurance $\Pr(X_3^2 \leq u) = \Pr(7.82 \leq 50.45)$. b) The percentage of insurance to primary femur cancer.
Figure 9: a) Amputation is defined as having one of the following ICD-9-CM procedure codes:
Lower limb amputation otherwise not specified (84.10), Amputation below the knee (84.15), Disarticulation of the knee (84.16), Amputation above the knee (84.17), Disarticulation of the hip (84.18) or abdominopelvic amputation (84.19). Of the 3,914 pediatric discharges from 2000-
2009 with a primary diagnosis of femur cancer, 248 had a principal procedure code for amputation. This trend is the total frequency of weighted discharges with a primary diagnosis of femur cancer as well as a primary procedure code (PR1) of amputation. Error bars, 95% Confidence Intervals. The overall trend from 2000-2009 is significantly changing \( \Pr(X^2 \leq u) = \Pr(7.82 \leq 17.64) \). B) The percentage of primary procedure code of amputation to primary femur cancer.

**Classification**

Figures 10-15, illustrate the total percentage of primary hip or femur procedures performed in the years 1997, 2000, 2003, 2006, 2009 and 2012 using domain analysis of HCUP participating states. The top three procedures performed on femur cancer patients each year are partial ostectomy of the right femur, partial ostectomy of the tibia, followed by amputation above the knee. Classification trees found in Figures 16-21 are then used to predict a discharges outcome based on the binary response variable amputation (1) or no amputation (0) based on characteristics of the patient. In this analysis no amputation represented limb-salvage patients only determined by one of the ICD-9 codes listed in Table 1. The covariates analyzed were gender (male=a, female=b), age, number of diagnosis, hospital region(Northeast=1, Midwest=2, South=3, West=4) and race ( White=1, Black=2, Hispanic=3, Asian or Pacific Islander=4, Native American=5, Other=6) for the years 1997, 2000, 2003, 2006, 2009 and 2012. APDRG Severity (No class specified and Minor loss of function are complication=0; Moderate loss of function, major loss of function and extreme loss of function are labeled as complication=1) was added starting with the year 2003. All values are unimputed and unweighted from HCUP participating states. Each classification tree is analyzed by year with the misclassification rate.

To predict a discharges risk for amputation or no amputation from the tree

\[
\Pr(Y=1) = \Pr(\text{Amputation}) = \frac{\text{Number of Amputations}}{\text{Total number of cases in the subgroup}} \times 100
\]
With a misclassification rate of

\[
\text{Misclassification\%} = \frac{\text{Total Number misclassified}}{\text{Total Number classified correctly}}
\]

**Figures 10:** Discharges with a primary hip or femur procedure code found in Table 1 and a primary diagnosis of femur cancer. The percentage of total primary procedures performed on primary femur cancer discharges is based on HCUP participating states in 1997. The highest procedure performed was partial ostectomy of the right femur, partial ostectomy of the Tibia, followed by amputation above the knee.
Figures 11: Primary femur cancer discharges with a primary hip or femur procedure code found in Table 1 and a primary diagnosis of femur cancer. The percentage of total primary procedures performed on primary femur cancer discharges is based on HCUP participating states in 2000. The highest procedure performed was partial ostectomy of the right femur, partial ostectomy of the Tibia, followed by amputation above the knee.
Figures 12: Primary femur cancer discharges with a primary hip or femur procedure code found in Table 1 and a primary diagnosis of femur cancer. The percentage of total primary procedures performed on primary femur cancer discharges is based on HCUP participating states in 2003. The highest procedure performed was partial ostectomy of the right femur, partial ostectomy of the Tibia, followed by amputation above the knee.
Figures 13: Primary femur cancer discharges with a primary hip or femur procedure code found in Table 1 and a primary diagnosis of femur cancer. The percentage of total primary procedures performed on primary femur cancer discharges is based on HCUP participating states in 2006. The highest procedure performed was partial ostectomy of the right femur, partial ostectomy of the Tibia, followed by amputation above the knee.
Figures 14: Primary femur cancer discharges with a primary hip or femur procedure code found in Table 1 and a primary diagnosis of femur cancer. The percentage of total primary procedures performed on primary femur cancer discharges is based on HCUP participating states in 2009. The highest procedure performed was partial ostectomy of the right femur, partial ostectomy of the Tibia, followed by amputation above the knee.
Figures 15: Primary femur cancer discharges with a primary hip or femur procedure code found in Table 1 and a primary diagnosis of femur cancer. The percentage of total primary procedures performed on primary femur cancer discharges is based on HCUP participating states in 2012. The highest procedure performed was partial ostectomy of the right femur, partial ostectomy of the Tibia, followed by amputation above the knee.
Figure 16: Amputation (Amp) versus No Amputation (No Amp) among patients receiving a hip or femur procedure. If the number of diagnosis is less than 4, the age less than 13, and race is white, black or Hispanic then the child will have a 66.7% chance of amputation. The misclassification rate is 38.71%.

Figure 17: Amputation (Amp) versus No Amputation (No Amp) among patients receiving a hip or femur procedure. If the region is the West, and the number of diagnosis is greater than 2, than there is a 52.63% of amputation with a misclassification rate of 27.84%.
Figure 18: Amputation (Amp) versus No Amputation (No Amp) among patients receiving a hip or femur procedure. If a child is classified as not complicated (Comp=0) there is a 100% chance of amputation with a misclassification rate of 16.28%.

Figure 19: If a child is considered not complicated (Comp=0) then the child will 100% be amputated (Amp). If the child is considered complicated (Comp=1), but has a number of diagnosis greater than 5 in the region Midwest or West, and is classified as black, Hispanic, Asian or other then there is a 57.14% chance of amputation (Amp). If the child is not considered complicated (Comp=0), but has a number of diagnosis greater than 5 in the region...
Midwest or West, and between the ages of 15-18 then the child has a 54.55% chance of amputation (Amp) with a misclassification rate of 19.35%.

Figure 20: If a child’s insurance is Public insurance, and greater than 15 years of age then the child has an 81.81% chance of amputation with a misclassification rate of 35.38%

Figure 21: If a child is not complicated (Comp=0) there is a 79.17% chance of amputation. If the child is complicated (Comp=1) but has a number of diagnosis greater than 12 there is 87.5% chance of amputation. The misclassification rate is 16.4
The two main factors predicting a child’s probability of amputation from the years 1997-2012 is number of diagnoses (NDX) and age. If the child is between the ages of 15 to 18 and has four or more number of diagnoses the probability of amputation is greater than 50 percent.

**Incidence Rate of Femur Cancer Cases**

The incidence rate of femur cancer for the years 2000-2009 is color coded by state. The KID 1997 and 2012 do not breakdown discharges by state and so are not included. The national estimate of primary femur cancer by state is determined by linear regression in order to predict non-HCUP partner states. The incidence rate is determined by United States census pediatric population 18 years of age and under. Areas shaded in gray have an incidence rate of 0.

Figure 22: The total femur cancer for 2000 is 1151 discharges. Massachusetts and Wisconsin have the highest incidence of femur cancer in 2000 of 94.9 and 48.5 per million children under 18 in the United States respectively.
Figure 23: The total femur cancer for 2006 is 971 discharges. Washington and Tennessee has the highest incidence of femur cancer in 2003 of 17.1 and 14.8 per million children under 18 in the United States respectively.
Figure 24: The total femur cancer for 2006 is 959 discharges. Massachusetts and Tennessee have the highest incidence of femur cancer in 2006 of 11.7 and 11.4 per million children under 18 in the United States respectively.
Figure 25: The total femur cancer for 2009 is 833 discharges. Tennessee has the highest incidence of femur cancer in 2009 of 16.1 per million children under 18 in the United States respectively.
**Basket Analysis**

The modeling technique used to investigate the top five ICD-9 codes listed for amputation or limb-salvage procedures in the target primary femur cancer population, is basket analysis. This technique assesses the number of times a diagnosis code (DX2….DXn) occurs in a femur cancer discharge who has been either amputated or not amputated.

\[
\text{IF}\{\text{DX}_2,\ldots,\text{DX}_n\} \text{ THEN } (\text{PR}_1=\text{amputated})^{22}
\]

\[
\text{IF}\{\text{DX}_2,\ldots,\text{DX}_n\} \text{ THEN } (\text{PR}_1=\text{not amputated})^{22}
\]

The support is the probability that a patient will have femur cancer with one of the diagnosis

\[
\text{Support(}\text{DX} \leftrightarrow \text{Amputation}) = P(\text{DX U Amputation})^{22}
\]

and the confidence is the conditional probability that the patient will have femur cancer or how often X appears with femur cancer

\[
\text{confidence(}\text{DX} \leftrightarrow \text{Amputation})= P(\text{Amputation}|\text{DX})^{22}
\]

A lift greater than one indicates that X and Y appear together more often than one would expect and one close to one means that there is zero correlation between X and Y

\[
\text{Lift(}\text{DX} \leftrightarrow \text{Amputation})= \frac{\text{confidence(}\text{DX} \leftrightarrow \text{Amputation})^{22}}{P(B)}
\]

The support, lift and conditional probabilities can be found in Table 6. The lift for primary femur cancer and limb salvage procedure is 1 and not included in the results.

Table 5 is the association between a secondary diagnosis of femur cancer and the top five diagnosis codes. Table 6 analyzed the top five diagnoses of a patient with a primary diagnosis of femur cancer along with a primary procedure of amputation.
**Multivariate Regression of Total Charges**

Multivariate regression analysis evaluated the relationship of the outcome variable total charges per day for the years 1997, 2000, 2003, 2006, 2009, and 2012 adjusting for LOS, number of diagnosis (NDX), age, gender, insurance type, complication (for the years 2003, 2006, 2009 and 2012), hospital region, and group (amputation or no amputation). The overall equation is

\[
\text{Total charges/day} = \beta_0 + \beta_1(NDX) + \beta_2(LOS) + \beta_3(Age) + \beta_4(Female) + \beta_5(Pay1) + \beta_6(Complication) + \beta_7(\text{Group}) + \beta_8(\text{hospital region})
\]

The total charges are defined as the amount that hospitals bill for services rendered but does not reflect the actual cost of hospital services or the amount hospitals receive for payment.

To account for the differences in state participation the total charges are divided by the total number of states participating in a particular year. Table 7 shows total charges per day by year.

Cost to charge ratios are available for the years 2003, 2006, 2009, and 2012 and adjust the total charges. The cost to charge ratio is multiplied by the total charges to determine actual costs or payment received by the hospital. Multivariate regression on the cost to charge ratios can be found in Table 8 for the cost to charge per day by year in patients with complications. Table 9 shows the cost to charge per day by year in patients without complications. The overall equation is

\[
\text{Cost to Charge/day} = \beta_0 + \beta_1(NDX) + \beta_2(LOS) + \beta_3(Age) + \beta_4(Female) + \beta_5(Pay1) + \beta_6(\text{Group}) + \beta_7(\text{hospital region})
\]

Total charges and cost to charge are cost adjusted to 2012 by the Consumer Price Index Calculator. All regression is two-sided 95% confidence level with a significant p-value of (p<0.05). Table 11 is a domain analysis of the cost to charge by state for the years 2003, 2006, and 2009.
Discussion

Primary femur cancer diagnosis accounts for approximately 1000 pediatric discharges or 0.028% of all pediatric non-birth discharges per year. The highest incidence rate of primary femur cancer was located in Massachusetts (19 per million), Iowa (15 per million), and Wisconsin (14 per million) in 2000; Washington (17 per million), Tennessee (15 per million), North Carolina (13 per million) in 2003; Massachusetts (12 per million), Tennessee (11 per million) and Rhode Island (11 per million) in 2006; Tennessee (16 per million), Arkansas (10 per million) and Washington (9 per million) in 2009.

A primary diagnosis of femur cancer is generally accompanied by a secondary diagnosis of some type of secondary malignancy or acute Posthemorrhagic anemia. The changing trend for primary femur cancer and for males and for females of femur cancer from 2000 to 2009 is not significantly changing. However, the trend is significantly changing, for the age groups 0-14, and 15-18, and for the insurance types public and private.

The number of discharges increases to approximately 5-6000 cases with a secondary diagnosis of femur cancer per year. The top reasons children are discharged with a secondary diagnosis of femur cancer is treatment for chemotherapy. The trend for the ratio of discharges with primary/secondary femur cancer to all other pediatric non-birth discharges is significantly changing for the years 2000 to 2009.

With the advancement of reconstructive surgery for pediatric femur cancer patients, the need for amputation has decreased dramatically over the past 40 years. With the increased survival rates due to cytotoxic chemotherapy treatment options have shifted from amputation to reconstructive limb-salvage surgery. Today, amputation accounts for less than 11% of all hip and femur operations coded as PR1. Survival rates are comparable for both treatment options, so for many patients determining the type of treatment for their situation is important due to aesthetic reasons and overall mobility. Amputations are generally based on the age of the patient, tumor location and extent of invasion. We found males and children between the ages...
of 15-18 years of age have a slightly higher risk for amputation which may be consistent with the higher proportion of femur cancer in these groups. Children labeled with 4 or more NDX, or those with diagnosis codes of secondary malignant neoplasm or anemia have a higher probability of amputation.

Amputation decreased total charges significantly but long-term care becomes more expensive due to adjustments and prosthetic fittings.\(^3\) Overall cost to charge per day for a femur cancer patient who has undergone amputation is significantly less than one who has not been amputated regardless of complication status (\(p<0.05\)). The increasing number of diagnoses significantly decreased the costs for patient listed as complicated, but not for those listed as uncomplicated (\(p<0.05\)). Age, gender, insurance and region did not have significant differences in overall cost to charge per day.

**Future Implications**

The survival rate of pediatric patients with malignant bone tumors has stagnated over the past 30 years and very little is known about possible risk factors, environmental or genetic, associated with the disease. Longitudinal studies of hospital care in the United States are critical to the advancement of Environmental Health research related to pediatric malignant bone tumors. These types of national studies help identify environmental and genetic factors (such as gender, age, race, etc.) associated with disease in order to improve/modify treatment options and outcomes.
### Table 1: International Classification of Diseases, Ninth Revision Procedure Codes

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Non-Amputations (Limb-Salvaging)</th>
<th>ICD-9</th>
<th>Amputations</th>
</tr>
</thead>
<tbody>
<tr>
<td>77.35</td>
<td>Removal of the articulation end of the bone</td>
<td>84.10</td>
<td>Lower limb amputation</td>
</tr>
<tr>
<td>77.65</td>
<td>Local excision of bone, tissue or lesion femur</td>
<td>84.15</td>
<td>Amputation below the knee</td>
</tr>
<tr>
<td>77.85</td>
<td>Other partial ostectomy of right femur</td>
<td>84.16</td>
<td>Disarticulation knee</td>
</tr>
<tr>
<td>77.87</td>
<td>Other partial ostectomy of tibia fibula</td>
<td>84.17</td>
<td>Amputation above the knee</td>
</tr>
<tr>
<td>77.95</td>
<td>Total ostectomy femur</td>
<td>84.18</td>
<td>Disarticulation hip</td>
</tr>
<tr>
<td>78.05</td>
<td>Bone graft femur</td>
<td>84.19</td>
<td>Abdominopelvic amputation</td>
</tr>
<tr>
<td>78.25</td>
<td>Limb shortening procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78.35</td>
<td>Limb lengthening procedures femur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78.55</td>
<td>Internal fixation bone fracture reduction femur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>79.35</td>
<td>Open reduction fracture internal fixation femur</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Tables

The following procedure codes were omitted from this study: Repair plastic operation (78.45), revision amputation stump (843) biopsy soft tissue (83.21), and disarticulation shoulder (84.08) since these procedures are a repair of a previous procedure, biopsy, or unrelated to a femur hip procedure.
<table>
<thead>
<tr>
<th>Year</th>
<th>Variable</th>
<th>N</th>
<th>Unimputed Mean</th>
<th>STDERR</th>
<th>Imputed Mean</th>
<th>STDERR</th>
<th>%Missing</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>LOS</td>
<td>388</td>
<td>7.258579</td>
<td>0.375443</td>
<td>7.257676</td>
<td>0.373368</td>
<td>0.77</td>
<td>0.997</td>
</tr>
<tr>
<td>1997</td>
<td>TOTCHG</td>
<td>373</td>
<td>30840</td>
<td>2163.992832</td>
<td>30613</td>
<td>2111.11436</td>
<td>4.61</td>
<td>0.9402</td>
</tr>
<tr>
<td>2000</td>
<td>TOTCHG</td>
<td>378</td>
<td>32580</td>
<td>2274.112396</td>
<td>32337</td>
<td>2048.69441</td>
<td>11.89</td>
<td>0.0794</td>
</tr>
<tr>
<td>2000</td>
<td>RACE</td>
<td>373</td>
<td>1.851303</td>
<td>0.087615</td>
<td>1.841675</td>
<td>0.07673</td>
<td>13.05</td>
<td>0.0827</td>
</tr>
<tr>
<td>2000</td>
<td>PAY1</td>
<td>428</td>
<td>2.932147</td>
<td>0.063972</td>
<td>2.931658</td>
<td>0.063851</td>
<td>0.23</td>
<td>0.005</td>
</tr>
<tr>
<td>2003</td>
<td>TOTCHG</td>
<td>534</td>
<td>54196</td>
<td>3423.486615</td>
<td>55393</td>
<td>3740.50862</td>
<td>2.01</td>
<td>0.8159</td>
</tr>
<tr>
<td>2003</td>
<td>RACE</td>
<td>398</td>
<td>2.093581</td>
<td>0.1111</td>
<td>2.112666</td>
<td>0.030103</td>
<td>27.21</td>
<td>0.8681</td>
</tr>
<tr>
<td>2003</td>
<td>FEMALE</td>
<td>536</td>
<td>0.461889</td>
<td>0.028486</td>
<td>0.456889</td>
<td>0.049911</td>
<td>1.81</td>
<td>0.9307</td>
</tr>
<tr>
<td>2003</td>
<td>AGE</td>
<td>540</td>
<td>13.823418</td>
<td>0.19937</td>
<td>13.260112</td>
<td>0.184502</td>
<td>1</td>
<td>0.0382</td>
</tr>
<tr>
<td>2006</td>
<td>TOTCHG</td>
<td>592</td>
<td>91850</td>
<td>4489.197709</td>
<td>90120</td>
<td>3526.11809</td>
<td>2.2</td>
<td>0.7638</td>
</tr>
<tr>
<td>2006</td>
<td>RACE</td>
<td>518</td>
<td>2.057082</td>
<td>0.092221</td>
<td>2.075777</td>
<td>0.112634</td>
<td>14.71</td>
<td>0.8978</td>
</tr>
<tr>
<td>2006</td>
<td>FEMALE</td>
<td>592</td>
<td>0.445771</td>
<td>0.020869</td>
<td>0.459138</td>
<td>0.02963</td>
<td>2.39</td>
<td>0.7136</td>
</tr>
<tr>
<td>2006</td>
<td>AGE</td>
<td>596</td>
<td>13.373967</td>
<td>0.204749</td>
<td>12.72207</td>
<td>0.199139</td>
<td>1.65</td>
<td>0.0247</td>
</tr>
<tr>
<td>2009</td>
<td>TOTCHG</td>
<td>592</td>
<td>91850</td>
<td>5252.046067</td>
<td>90120</td>
<td>5462.04613</td>
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<td>0.8194</td>
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<td>2009</td>
<td>RACE</td>
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<td>2.057082</td>
<td>0.080835</td>
<td>2.075777</td>
<td>0.075974</td>
<td>14.71</td>
<td>0.8662</td>
</tr>
<tr>
<td>2009</td>
<td>FEMALE</td>
<td>592</td>
<td>0.445771</td>
<td>0.026509</td>
<td>0.459138</td>
<td>0.028144</td>
<td>2.39</td>
<td>0.7307</td>
</tr>
<tr>
<td>2009</td>
<td>AGE</td>
<td>596</td>
<td>13.373967</td>
<td>0.191881</td>
<td>12.72207</td>
<td>0.172039</td>
<td>1.65</td>
<td>0.0115</td>
</tr>
<tr>
<td>2012</td>
<td>TOTCHG</td>
<td>585</td>
<td>107160</td>
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<td>106921</td>
<td>5555.53931</td>
<td>3</td>
<td>1.69</td>
</tr>
<tr>
<td>2012</td>
<td>RACE</td>
<td>513</td>
<td>2.099695</td>
<td>0.097614</td>
<td>2.86176</td>
<td>0.06613</td>
<td>14.58</td>
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</tr>
<tr>
<td>2012</td>
<td>PAY1</td>
<td>593</td>
<td>2.872111</td>
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<td>2.110202</td>
<td>0.088597</td>
<td>0.19</td>
<td>0.0001</td>
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</table>

Table 2: Imputed values by year for the unimputed mean and the imputed mean with corresponding standard error (STDERR), and the percent missing (%Missing). A p-value of (p<0.05) is considered significant. An insignificant p-value suggests that the imputed versus the unimputed will not have a significant impact on the dataset.
### Top 5 DX2 ICD-9 Codes For Primary Femur Cancer 1997

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>197</td>
<td>Secondary Malignant</td>
<td>9.72</td>
</tr>
<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>6.65</td>
</tr>
<tr>
<td>288</td>
<td>Neutropenia</td>
<td>2.56</td>
</tr>
<tr>
<td>198.5</td>
<td>Secondary Malignant Neoplasm of the long bone</td>
<td>2.30</td>
</tr>
<tr>
<td>198.89</td>
<td>Secondary Malignant Neoplasm Other</td>
<td>2.05</td>
</tr>
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</table>

### Top 5 DX2 ICD-9 Codes For Primary Femur Cancer for 2000

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>197</td>
<td>Secondary Malignant</td>
<td>12.68</td>
</tr>
<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>3.95</td>
</tr>
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<td>288</td>
<td>Neutropenia</td>
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<td>285.9</td>
<td>Anemia/ Unspecified</td>
<td>2.08</td>
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<tr>
<td>198.5</td>
<td>Secondary Malignant Neoplasm of the long bone</td>
<td>1.25</td>
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### Top 5 DX2 ICD-9 Codes For Primary Femur Cancer for 2003

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>197</td>
<td>Secondary Malignant</td>
<td>9.54</td>
</tr>
<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>2.75</td>
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<td>284.8</td>
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<td>198.5</td>
<td>Secondary Malignant Neoplasm of the long bone</td>
<td>2.20</td>
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<tr>
<td>493.9</td>
<td>Asthma/ unspecified</td>
<td>2.20</td>
</tr>
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</table>

### Top 5 DX2 ICD-9 Codes For Primary Femur Cancer for 2006

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
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</thead>
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<tr>
<td>197</td>
<td>Secondary Malignant</td>
<td>10.15</td>
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<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>3.44</td>
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<tr>
<td>285.9</td>
<td>Anemia Unspecified</td>
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<tr>
<td>198.5</td>
<td>Secondary Malignant Neoplasm of the long bone</td>
<td>2.41</td>
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<tr>
<td>493.9</td>
<td>Asthma/ unspecified</td>
<td>2.24</td>
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### Top 5 DX2 ICD-9 Codes For Primary Femur Cancer for 2009

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
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<tr>
<td>197</td>
<td>Secondary Malignant</td>
<td>6.61</td>
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<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>3.31</td>
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<tr>
<td>198.5</td>
<td>Secondary Malignant Neoplasm of the long bone</td>
<td>2.64</td>
</tr>
<tr>
<td>733.1</td>
<td>Pathologic Fracture of Other Specified Part of Femur</td>
<td>2.31</td>
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<tr>
<td>285.9</td>
<td>Secondary Malignant Neoplasm of the long bone</td>
<td>1.98</td>
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### Top 5 DX2 ICD-9 Codes For Primary Femur Cancer for 2012

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
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<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
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<tr>
<td>338.1</td>
<td>Other acute post operative pain</td>
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</tr>
<tr>
<td>198.5</td>
<td>Secondary Malignant Neoplasm of the long bone</td>
<td>2.86</td>
</tr>
<tr>
<td>285.9</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>2.69</td>
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</table>

Table 3: Top 5 secondary ICD-9 codes (DX2) associated with primary femur cancer.

### Top 5 ICD-9 Codes For Primary Femur Cancer 1997

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>197</td>
<td>Secondary Malignant</td>
<td>11.51</td>
</tr>
<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>10.49</td>
</tr>
<tr>
<td>780.6</td>
<td>Fever/ Unspecified</td>
<td>8.44</td>
</tr>
<tr>
<td>285.9</td>
<td>Anemia/ Unspecified</td>
<td>6.91</td>
</tr>
<tr>
<td>288</td>
<td>Neutropenia</td>
<td>6.14</td>
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</table>

### Top ICD-9 Codes For Primary Femur Cancer 2000

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>197</td>
<td>Secondary Malignant</td>
<td>13.72</td>
</tr>
<tr>
<td>285.9</td>
<td>Anemia/ Unspecified</td>
<td>8.32</td>
</tr>
<tr>
<td>E933.</td>
<td>Antineoplastic and Immunosuppressive drugs causing adverse effects in therapeutic use</td>
<td>6.65</td>
</tr>
<tr>
<td>285.1</td>
<td>Acute Posthemorrhagic Anemia</td>
<td>5.82</td>
</tr>
<tr>
<td>780.6</td>
<td>Fever/ Unspecified</td>
<td>4.99</td>
</tr>
</tbody>
</table>

### Top 5 ICD-9 Codes for Primary Femur Cancer 2003

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>Diagnosis</th>
<th>Percent</th>
</tr>
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<td>Acute Posthemorrhagic Anemia</td>
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<tr>
<td>787.01</td>
<td>Nausea with vomiting</td>
<td>4.77</td>
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## Top 5 ICD-9 Codes For Primary Femur Cancer 2006

<table>
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<td>Anemia Unspecified</td>
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## Top 5 ICD-9 Codes For Primary Femur Cancer 2009

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<td>Post procedural fever</td>
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<td>338.18</td>
<td>Other acute post operative pain</td>
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## Top 5 ICD-9 Codes For Primary Femur Cancer 2012

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<th>Percent</th>
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Table 4: Top 5 combined ICD-9 codes associated with primary femur cancer. There is no distinction of whether the diagnosis is DX2, DX3,………,DX25 and is determined by domain analysis.
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<th>ICD-9 Code</th>
<th>Diagnosis</th>
<th>ICD-9 Code</th>
<th>Associated Diagnosis</th>
<th>Support</th>
<th>Confidence</th>
<th>Lift</th>
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<tbody>
<tr>
<td>V58.1</td>
<td>Encounter for Chemotherapy and immunotherapy for neoplastic conditions</td>
<td>V43.65</td>
<td>Organ Tissue Replaced by other means (knee)</td>
<td>0.0119</td>
<td>1.00</td>
<td>1.56</td>
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<td>Nausea, vomiting</td>
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<td>1.00</td>
<td>1.56</td>
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<td>Anemia, Unspecified</td>
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<td>1.00</td>
<td>1.56</td>
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<td>E933.1</td>
<td>Primary systemic agents Antineoplastic and immunosuppressive drugs</td>
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<td>V49.76</td>
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<td>Stomatitis and mucositis (ulcerative)</td>
<td>0.006</td>
<td>0.92</td>
<td>1.81</td>
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| V58.11     | Encounter For Antineoplastic Chemotherapy | V49.76     | Other conditions influencing health status  
Lower limb amputations status above knee  
Disarticulation of knee                  | 0.012   | 0.92       | 1.8  |
| V49.76     | Other conditions influencing health status  
Lower limb amputations status above knee  
Disarticulation of knee                  | 0.013   | 0.91       | 1.79 |
<p>| V58.11     | Encounter For Antineoplastic Chemotherapy | 564.0      | Constipation, unspecified                                                             | 0.009   | 0.90       | 1.78 |
| V58.11     | Encounter For Antineoplastic Chemotherapy | 787.01     | Nausea, vomiting                                                                     | 0.016   | 0.90       | 1.76 |</p>
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<th>ICD-9 Code</th>
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<th>ICD-9 Code</th>
<th>Associated Diagnosis</th>
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<th>Confidence</th>
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<td>Nausea, vomiting</td>
<td>0.016</td>
<td>0.90</td>
<td>1.76</td>
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</table>

Table 5: Basket Analysis was used to analyze the top five diagnosis of a patient with secondary femur cancer and their associated diagnosis each year. The top reason for a secondary diagnosis of femur cancer is treatment for chemotherapy which is associated with a diagnosis of Organ Tissue Replaced by other means (knee) (1997), Anemia, Unspecified (2000), Asthma, unspecified(2003), Stomatitis and mucositis (ulcerative) (2006, 2009, 2012).
### KID1997

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<th>ICD-9 Code</th>
<th>Diagnosis</th>
<th>ICD-9 Code</th>
<th>Associated Diagnosis</th>
<th>Support</th>
<th>Confidence</th>
<th>Lift</th>
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<tr>
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<td>1.00</td>
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<td>Pervasive Developmental Disorders/Autistic Disorder</td>
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<td>0.008</td>
<td>1.00</td>
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<td>1.00</td>
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<td>Congenital Pigmentary Anomalies of Skin</td>
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### KID2000

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<th>Confidence</th>
<th>Lift</th>
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<td>Secondary Malignant Neoplasm/ Other Specified Site</td>
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<td>Secondary malignant Neoplasm/ Lung</td>
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<td>1.00</td>
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<tr>
<td>277.00</td>
<td>Cystic Fibrosis without mention of Meconium Ileus</td>
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<td>1.00</td>
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</tr>
<tr>
<td>353.6</td>
<td>Nerve Root and Plexus Disorders/ Phantom Limb (Syndrome)</td>
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<tr>
<td>528.9</td>
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<th>Support</th>
<th>Confidence</th>
<th>Lift</th>
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### KID2006

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<th>Support</th>
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### KID2012

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Table 6: Basket Analysis was used to analyze the top five diagnosis of a patient with a primary diagnosis of femur cancer along with a primary procedure of amputation.
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|-----------------|----------|-----------|------|---|-----------------|----------|-----------|------|---|-----------------|----------|-----------|------|---|-----------------|----------|-----------|------|---|
| intercept       | 332.71   | 112.09    | 0.0031|   | intercept       | 391.44   | 94.18    | &lt;.0001|   |
| 15-18 Years     | 83.76    | 58.43     | 0.1517|   | 15-18 Years     | 21.89    | 46.22    | 0.6358|   |
| 5-9 Years       | 60.49    | 65.82     | 0.3581|   | 5-9 Years       | -66.49   | 45.31    | 0.1422|   |
| 10-14 Years     | 79.89    | 59.59     | 0.18  |   | 10-14 Years     | -22.88   | 44.76    | 0.6092|   |
| 0-4 Years       | 0.00     | 0.00      | .    |   | 0-4 Years       | 0.00     | 0.00     | .    |   |
| Male            | 34.98    | 22.25     | 0.1161|   | Male            | 5.45     | 19.01    | 0.7747|   |
| Female          | 0.00     | 0.00      | .    |   | Female          | 0.00     | 0.00     | .    |   |
| Public          | -79.20   | 72.43     | 0.2753|   | Public          | -41.65   | 81.57    | 0.6126|   |
| Private         | -29.65   | 67.17     | 0.6594|   | Private         | -27.24   | 79.10    | 0.7327|   |
| Other           | 0.00     | 0.00      | .    |   | Other           | 0.00     | 0.00     | .    |   |
| NDX             | -18.11   | 4.53      | &lt;.0001|   | NDX             | -9.40    | 4.12     | 0.0237|   |
| Amputation      | -55.05   | 19.74     | 0.0054|   | Amputation      | -64.55   | 41.85    | 0.1274|   |
| No Amputation   | 0.00     | 0.00      | .    |   | No Amputation   | 0.00     | 0.00     | .    |   |
| Northeast       | -12.41   | 47.61     | 0.7943|   | Northeast       | -77.30   | 24.66    | 0.0017|   |
| Midwest         | -53.22   | 41.85     | 0.2037|   | Midwest         | -46.23   | 32.39    | 0.1537|   |
| South           | -16.23   | 38.49     | 0.6733|   | South           | -56.19   | 30.32    | 0.0663|   |
| West            | 0        | 0         | .    |   | West            | 0        | 0        | .    |   |
| Parameter  | 2003 Estimate | Std Error | Pr &gt; |t| | Parameter  | 2006 Estimate | Std Error | Pr &gt; |t|
|------------|---------------|-----------|------|-----------------|------------|-----------|-----------|------|
| intercept  | 453.33        | 165.85    | 0.0063 | intercept       | 476.82     | 78.22     | &lt;.0001    |
| 15-18 Years | -69.09        | 162.35    | 0.6704 | 15-18 Years     | -15.57     | 70.05     | 0.8241    |
| 5-9 Years  | -109.28       | 159.94    | 0.4944 | 5-9 Years       | -71.58     | 71.61     | 0.3175    |
| 10-14 Years| -109.64       | 161.33    | 0.4967 | 10-14 Years     | 3.87       | 70.05     | 0.9559    |
| 0-4 Years  | 0.00          | 0.00      | .     | 0-4 Years       | 0.00       | 0.00      | .         |
| Male       | 22.72         | 17.02     | 0.182 | Male            | -1.22      | 19.68     | 0.9506    |
| Female     | 0.00          | 0.00      | .     | Female          | 0.00       | 0.00      | .         |
| Public     | -61.41        | 31.50     | 0.0512 | Public          | 32.02      | 40.70     | 0.4314    |
| Private    | -15.09        | 32.26     | 0.6399 | Private         | 55.91      | 44.45     | 0.2085    |
| Other      | 0.00          | 0.00      | .     | Other           | 0.00       | 0.00      | .         |
| NDX        | -5.76         | 3.77      | 0.1263 | NDX             | -11.25     | 2.76      | &lt;.0001    |
| Amputation | -72.41        | 29.22     | 0.0148 | Amputation      | -116.56    | 25.88     | &lt;.0001    |
| No Amputation | 0.00        | 0.00      | .     | No Amputation   | 0.00       | 0.00      | .         |
| Northeast  | -83.26        | 34.90     | 0.0171 | Northeast       | -146.30    | 43.11     | 0.0007    |
| Midwest    | -48.43        | 33.98     | 0.1541 | Midwest         | -129.12    | 42.58     | 0.0025    |
| South      | -65.89        | 35.70     | 0.065 | South           | -141.38    | 37.89     | 0.0002    |
| West       | 0.00          | 0.00      | .     | West            | 0.00       | 0.00      | .         |</p>
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Table 7: Total charges per day for a child diagnosed with primary femur cancer: Costs are divided by the number of states represented for that year and cost adjusted to 2012 by the Consumer Price Index Calculator. All estimates are rounded to the nearest cent. Other includes self-pay, no pay and other. A p-value of (p<0.05) is considered significant.
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Table 8: Cost to charge per day for a child diagnosed with primary femur cancer listed as complicated: Costs are divided by the number of states represented for that year and cost adjusted to 2012 by the Consumer Price Index Calculator. All estimates are rounded to the nearest cent. Other includes self-pay, no pay and other. A p-value of (p<0.05) is considered significant.
| Parameter  | Estimate | Std Error | Pr > |t| | Parameter  | Estimate | Std Error | Pr > |t| |
|------------|----------|-----------|------|---|------------|----------|-----------|------|---|------------|----------|-----------|------|---|
| intercept  | 75.41    | 14.76     |      |   | intercept  | -10.84   | 116.61    | 0.9259|   |
| 15-18 Years| 3.28     | 12.78     |      |   | 15-18 Years| 86.06    | 77.85     | 0.269 |   |
| 5-9 Years  | 51.94    | 8.18      |      |   | 5-9 Years  | -15.15   | 41.05     | 0.712 |   |
| 10-14 Years| 0.00     | 0.00      |      |   | 10-14 Years| 18.01    | 48.53     | 0.7106|   |
| 0-4 Years  | .        | .         |      |   | 0-4 Years  | 0.00     | 0.00      | .     |   |
| Male       | -1.96    | 11.07     |      |   | Male       | -39.14   | 45.48     | 0.3894|   |
| Female     | 0.00     | 0.00      |      |   | Female     | 0.00     | 0.00      | .     |   |
| Public     | 7.34     | 19.67     |      |   | Public     | 103.26   | 127.13    | 0.4166|   |
| Private    | 31.73    | 13.42     |      |   | Private    | 119.98   | 130.80    | 0.359 |   |
| Other      | 0.00     | 0.00      |      |   | Other      | 0.00     | 0.00      | .     |   |
| NDX        | 1.58     | 2.80      |      |   | NDX        | -1.45    | 10.04     | 0.8849|   |
| Amputation | -37.51   | 15.92     |      |   | Amputation | -5.88    | 68.55     | 0.9316|   |
| No Amputation | 0.00 | 0.00 |      |   | No Amputation | 0.00 | 0.00 | . |   |
| Northeast  | 65.67    | 48.63     |      |   | Northeast  | 7.34     | 51.94     | 0.8877|   |
| Midwest    | 23.81    | 20.53     |      |   | Midwest    | 20.37    | 54.94     | 0.7108|   |
| South      | 22.85    | 23.03     |      |   | South      | -50.04   | 26.88     | 0.0627|   |
| West       | 0.00     | 0.00      |      |   | West       | 0.00     | 0.00      | .     |   |
### Table 9: Cost to charge per day for a child diagnosed with primary femur cancer listed as not complicated

Costs are divided by the number of states represented for that year and cost adjusted to 2012 by the Consumer Price Index Calculator. All estimates are rounded to the nearest cent. Other includes self-pay, no pay and other. There are no 0-4 year olds listed as not complicated in 2003 and other is not represented in 2009 and 2012. A p-value of (p<0.05) is considered significant.
| Parameter       | 2003 Estimate | Std Error | Pr > |t| | Parameter       | 2006 Estimate | Std Error | Pr > |t| |
|-----------------|---------------|-----------|------|---|-----------------|---------------|-----------|------|---|-----------------|---------------|-----------|------|---|-----------------|---------------|-----------|------|---|
| intercept       | 119.00        | 16.90     | <.0001|   | intercept       | 69.99         | 22.34     | 0.0017|   |
| 0-4 Years       | 51.00         | 80.58     | 0.5268|   | 0-4 Years       | -45.39        | 17.55     | 0.0097|   |
| 5-9 Years       | -7.57         | 14.92     | 0.6121|   | 5-9 Years       | -23.68        | 11.17     | 0.034 |   |
| 10-14 Years     | -18.67        | 8.65      | 0.0309|   | 10-14 Years     | -13.25        | 9.08      | 0.1444|   |
| 15-18 Years     | 0.00          | 0.00      | .    |   | 15-18 Years     | 0.00          | 0.00      | .    |   |
| Male            | 11.02         | 7.42      | 0.1373|   | Male            | -3.94         | 7.85      | 0.6159|   |
| Female          | 0.00          | 0.00      | .    |   | Female          | 0.00          | 0.00      | .    |   |
| Public          | -14.63        | 13.75     | 0.2871|   | Public          | 37.65         | 15.69     | 0.0164|   |
| Private         | -4.30         | 11.81     | 0.7158|   | Private         | 42.66         | 15.27     | 0.0052|   |
| Other           | 0.00          | 0.00      | .    |   | Other           | 0.00          | 0.00      | .    |   |
| NDX             | -6.12         | 1.73      | 0.0004|   | NDX             | -2.37         | 0.99      | 0.0163|   |
| No Amputation   | 51.21         | 8.82      | <.0001|   | No Amputation   | 45.71         | 8.56      | <.0001|   |
| No Complication | -9.88         | 13.66     | 0.4692|   | No Complication | 12.19         | 11.77     | 0.3005|   |
| complication    | 0.00          | 0.00      | .    |   | complication    | 0.00          | 0.00      | .    |   |
| Northeast       | -21.99        | 14.67     | 0.1339|   | Northeast       | -25.60        | 15.86     | 0.1066|   |
| Midwest         | -2.26         | 13.17     | 0.8636|   | Midwest         | 14.25         | 16.53     | 0.3885|   |
| South           | -26.90        | 13.80     | 0.0513|   | South           | -8.78         | 11.50     | 0.4449|   |
| West            | 0.00          | 0.00      | .    |   | West            | 0.00          | 0.00      | .    |   |
| Parameter       | Estimate | Std Error | Pr > |t| | Parameter       | Estimate | Std Error | Pr > |t| |
|-----------------|----------|-----------|------|---|-----------------|----------|-----------|------|---|
| intercept       | 73.88    | 23.58     | 0.0017 |   | intercept       | 303.59   | 64.08     | <.0001 |   |
| 0-4 Years       | -47.91   | 18.53     | 0.0097 |   | 0-4 Years       | -72.15   | 80.33     | 0.369  |   |
| 5-9 Years       | -24.99   | 11.79     | 0.034  |   | 5-9 Years       | -19.71   | 42.21     | 0.641  |   |
| 10-14 Years     | -13.99   | 9.59      | 0.1444 |   | 10-14 Years     | -34.29   | 28.04     | 0.221  |   |
| 15-18 Years     | 0.00     | 0.00      | .     |   | 15-18 Years     | 0.00     | 0.00      | .     |   |
| Male            | -4.16    | 8.29      | 0.6159 |   | Male            | 19.56    | 23.61     | 0.407  |   |
| Female          | 0.00     | 0.00      | .     |   | Female          | 0.00     | 0.00      | .     |   |
| Public          | 39.74    | 16.56     | 0.0164 |   | Public          | 47.93    | 49.85     | 0.337  |   |
| Private         | 45.03    | 16.11     | 0.0052 |   | Private         | 87.34    | 50.06     | 0.082  |   |
| Other           | 0.00     | 0.00      | .     |   | Other           | 0.00     | 0.00      | .     |   |
| NDX             | -2.50    | 1.04      | 0.0163 |   | NDX             | -10.08   | 3.06      | 0.001  |   |
| No Amputation   | 48.25    | 9.04      | <.0001 |   | No Amputation   | 195.50   | 27.90     | <.0001 |   |
| No complication | 12.87    | 12.43     | 0.3005 |   | No complication | -13.60   | 42.38     | 0.748  |   |
| complication     | 0.00     | 0.00      | .     |   | complication     | 0.00     | 0.00      | .     |   |
| Northeast       | -27.02   | 16.75     | 0.1066 |   | Northeast       | -78.31   | 60.96     | 0.199  |   |
| Midwest         | 15.04    | 17.44     | 0.3885 |   | Midwest         | -119.25  | 42.29     | 0.005  |   |
| South           | -9.27    | 12.14     | 0.4449 |   | South           | -84.45   | 48.29     | 0.08   |   |
| West            | 0.00     | 0.00      | .     |   | West            | 0.00     | 0.00      | .     |   |

Table 10: Cost to charge per day for a child with primary femur cancer: Cost to charge per day for a child diagnosed with primary femur cancer: Costs are divided by the number of states represented for that year and cost adjusted to 2012 by the Consumer Price Index Calculator. All estimates are rounded to the nearest cent. Other includes self-pay, no pay and other. A p-value of (p<0.05) is considered significant.
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Table 11: Cost to Charge by State using domain analysis
References


18. CPI Inflation Calculator available at http://data.bls.gov/cgi-bin/cpicalc.pl

19. Statistical analysis was performed using SAS version 9.4 (SAS institute, Cary, North Carolina)


SAS Code

DATA k1;
set k1997.KID_1997_CORE_TrendWt;
run;
DATA k2;
set k1997.KID_1997_all;
run;
data k1997;
merge k1 k2;
by recnum;
run;

proc contents data=k1997 varnum;
run;

****Unimputed***********;
data femurCancer;
set k1997;
if DX1 in ("1707");
DISCHGS = 1;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age >= 5) and (age<=9) then grAge = "5-9";
if (age >= 10) and (age<=14) then grAge = "10-14";
if (age >= 15) and (age<=18) then grAge = "15-18";
if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =1;
if PR1 in ("7735", "7765", "7785","7787","7795","7805","7825","7835","7855",
"7935") then group =0;
run;

****7735", "7765", "7785","7795","7805","7825","7835","7855",
"7935",**;
data combined1;
set FemurCancer
k1997 (IN=Inhosp keep=hospnum stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;
proc surveymeans data=combined1;
weight discwt;
class race pay1 sex;
cluster hospnum;
strata stratum;
var dischgs LOS Totchg NDX race pay1 sex;
domain insubset;
run;

*****p value*****;
data k1997ii;
set k1997;
if hospbrth=0;
  if (age<=18);
    if (race=1) then nrace="White";
    if (race=2) then nrace="Black";
    if (race=3) then nrace="Hispanic";
    if (race=4) or (race=5) or (race=6) then nrace="Other";
    if (Pay1=1) or (Pay1=2) then nPay1="Public";
    if (Pay1=3) then nPay1="Private";
    if (Pay1=4) or (Pay1=5) then nPay1="Other";
    if (age<=4) then grAge = "1";
    if (age >= 5) and (age <=9) then grAge = "2";
    if (age >= 10) and (age <=14) then grAge = "3";
    if (age >= 15) and (age <=18) then grAge = "4";
run;
proc surveyfreq data=k1997ii;
weight discwt;
cluster hospnum;
strata stratum;
table sex grage nPay1;
run;
proc means data=femurcancer nmiss;
var LOS Totchg NDX race pay1 sex;
run;
proc ttest data=femurcancer h0=7.26;
var LOS;
run;
proc ttest data=femurcancer h0=30619;
var totchg;
run;
proc surveyfreq data=femurcancer ;
weight discwt;
stratum stratum;
cluster hospnum;
table cancer/cl;
run;
data allffracture1997;
set k1997;
  if DX1 in ("1707") or DX2 in ("1707");
  DISCHGS = 1;
  if (race=1) then nrace="White";
  if (race=2) then nrace="Black";
  if (race=3) then nrace="Hispanic";
  if (race=4) or (race=5) or (race=6) then nrace="Other";
  if (Pay1=1) or (Pay1=2) then nPay1="Public";
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  if (Pay1=4) or (Pay1=5) then nPay1="Other";
  if (age<=4) then grAge = "1";
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  if (age >= 10) and (age <=14) then grAge = "3";
  if (age >= 15) and (age <=18) then grAge = "4";
  if PR1 in ("7735", "7765", "7785","7787","7795","7805","7825","7835","7855",
  "7935","8410","8415","8416","8417","8418","8419") then Group =1; else group=0;
run;
data allcombined1;
set FemurCancer
k1997 (IN=Inhosp keep=hospnum stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
  end;
run;
proc surveymeans data=allcombined1 sum std mean stderr;
  weight discwt;
  class nrace npay1 sex;
  cluster hospnum;
  strata stratum;
  var dischgs LOS Totchg NDX nRACE nPay1 SEX AGE;
  domain insubset;
run;
proc ttest data=allffracture1997 h0=4.49;
  var LOS;
run;
proc ttest data=allffracture1997 h0=15509;
  var totchg;
run;
data femurCancerall;
  set k1997;
  if DX1 in ("1707") or DX2 in ("1707") then cancer=1; else cancer=0;
run;
data k1997ii;
set k1997;
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >= 10) and (age <=14) then grAge = "3";
if (age >= 15) and (age <=18) then grAge = "4";
run;
proc surveyfreq data=femurcancer;
weight discwt;
stratum stratum;
cluster hospnum;
table Totchg;
table NDX;
table RACE;
table Pay1;
table SEX;
table AGE;
run;

data femurCancerII;
set k1997;
if DX1 in ("1707");
DISCHGS = 1;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >= 10) and (age <=14) then grAge = "3";
if (age >= 15) and (age <=18) then grAge = "4";
if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =1; else group=0;
run;

data combinedamp;
set FemurCancer FemurCancerII;
if inhosp then do;
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;

**proc surveymeans** data=combinedamp sum std mean stderr;
weight discwt;
class nrace npay1 sex;
cluster hospnum;
strata stratum;
var dischgs LOS Totchg NDX nRACE nPay1 SEX AGE;
domain insubset;
run;

data allffracture1997II;
set k1997;
   if DX1 in ("1707") or DX2 in ("1707");
      DISCHGS = 1;
   if (race=1) then nrace="White";
   if (race=2) then nrace="Black";
   if (race=3) then nrace="Hispanic";
   if (race=4) or (race=5) or (race=6) then nrace="Other";
   if (Pay1=1) or (Pay1=2) then nPay1="Public";
   if (Pay1=3) then nPay1="Private";
   if (Pay1=4) or (Pay1=5) then nPay1="Other";
   if (age<=4) then grAge = "1";
   if (age >= 5) and (age <=9) then grAge = "2";
   if (age >= 10) and (age <=14) then grAge = "3";
   if (age >= 15) and (age <=18) then grAge = "4";
   if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =1; else group=0;
run;

data allcombinedlamp;
set allffracture1997
   k1997 (IN=Inhosp keep=hospnum stratum);
инsubset=1;
   if inhosp then do;
инsubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;

**proc surveymeans** data=allcombinedlamp sum std mean stderr;
weight discwt;
class nrace npay1 sex;
cluster hospnum;
strata stratum;
var dischgs LOS Totchg NDX nRACE nPay1 SEX AGE;
domain insubset;
run;
******************Imputed*******************************;
data ffracture1997;
  set k1997;
  if DX1 in ("1707");
  DISCHGS = 1;
run;
proc mi nimpute=0 data=ffracture1997;
  var age sex NDX LOS1 Pay1 race Totchg;
run;
proc mi data=ffracture1997 nimpute=10 seed=563 out=outfracturefull1997;
  class Pay1 race;
  fcs discrim (Pay1=age NDX LOS Totchg/details);
  fcs discrim (race=age NDX Los Totchg/details);
  fcs reg (LOS=age sex NDX/details);
  fcs reg (Totchg=age sex NDX LOS Pay1 race);
  var age sex NDX LOS Pay1 race Totchg;
run;
data FemurCancer;
  set outfracturefull1997;
  DISCHGS = 1;
run;
data combined;
  set FemurCancer k1997 (IN=Inhosp keep=hospnum stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
    pay1=0;
    race=0;
    age=0;
    sex=0;
    NDX=0;
  end;
run;
proc surveymeans data=combined;
  weight discwt;
  cluster hospnum;
  strata stratum;
  var dischgs LOS Totchg age sex NDX pay1 race;
  domain insubset;
  ods output domain=comb1997;
run;
proc mianalyze data=comb1997;
  modeleffects mean;
  stderr stderr;
run;

data allffracture1997;
set k1997;
  if DX1 in ("1707") or DX2 in ("1707");
  DISCHGS = 1;
run;
proc mi nimp=0 data=allffracture1997;
var age sex NDX LOS Pay1 race Totchg;
run;
proc mi data=allffracture1997 nimp=10 seed=563 out=alloutfracturefull1997;
class Pay1 race sex;
fcs reg (LOS=age sex NDX);
fcs discrim (Pay1=age NDX LOS Totchg);
fcs discrim (race=age NDX LOS Totchg);
fcs reg (Totchg=age sex NDX LOS Pay1 race);
var age sex NDX LOS Pay1 race Totchg;
run;
data allFemurCancer ;
  set alloutfracturefull1997;
  DISCHGS = 1 ;
run;
data allcombined;
set allFemurCancer k1997 (IN=Inhosp keep=hospnum stratum);
insubset=1;
if inhosp then do;
  insubset=2;
  discwt=1;
  died=0;
  dischgs=0;
  LOS=0;
  Totchg=0;
  pay1=0;
  race=0;
  age=0;
  sex=0;
  NDX=0;
end;
run;
proc surveymeans data=allcombined;
  weight discwt;
  cluster hospnum;
  strata stratum;
  var dischgs LOS Totchg NDX;
  domain insubset;
  ods output domain=allcomb1997;
run;
proc mianalyze data=allcomb1997;
  modeleffects mean;
  stderr stderr;
run;

2000
DATA k12000;
set k2000.KID_2000_CORE;
run;
DATA k22000;
set k2000.KID_2000_hospital;
run;
data k2000;
merge k12000 k22000;
by hospid;
run;

proc contents data=k2000.KID_2000_core varnum;
run;

****Missing Data************;
data femurCancer2000;
set k2000;
if (age<=18);
if DX1 in ("1707");
DISCHGS = 1;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >= 10) and (age <=14) then grAge = "3";
if (age >= 15) and (age <=18) then grAge = "4";
if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =1;
if PR1 in ("7735","7765","7785","7787","7795","7805","7825","7835","7855", "7935") then group=0;
run;

data combined2000;
set FemurCancer2000
k2000 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;

**proc surveymeans data=combined2000;**
weight discwt;
cluster hospid;
strata kid_stratum;
var dischgs LOS age female NDX totchg race Pay1;
domain insubset;
run;

*****p value*****;

**data k2000ii;**
set k2000;
if hospbrth=0;
if (age<=18);
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <= 9) then grAge = "2";
if (age >= 10) and (age <= 14) then grAge = "3";
if (age >= 15) and (age <= 18) then grAge = "4";
run;

**proc surveyfreq data=k2000ii;**
weight discwt;
cluster hospid;
strata kid_stratum;
table female grage npay1;
run;

**proc surveymeans data=k2000ii;**
weight discwt;
cluster hospid;
strata kid_stratum;
var LOS;
run;

**proc surveymeans data=combined2000;**
weight discwttcharge;
cluster hospid;
strata kid_stratum;
var Totchg;
domain insubset;
run;
proc ttest data=femurcancer2000 h0=34006;
  var totchg;
run;

data femurCancer2000;
  set k2000;
  if DX1 in ("1707") then cancer=1; else cancer=0;
run;

proc surveyfreq data=femurcancer2000;
  weight discwt;
  stratum kid_stratum;
  cluster hospid;
  table cancer/cl;
run;

data allffracture2000;
  set k2000;
  if DX1 in ("1707") or DX2 in ("1707");
  if (age<=18);
    DISCHGS = 1;
  if (race=1) then nrace="White";
  if (race=2) then nrace="Black";
  if (race=3) then nrace="Hispanic";
  if (race=4) or (race=5) or (race=6) then nrace="Other";
  if (Pay1=1) or (Pay1=2) then nPay1="Public";
  if (Pay1=3) then nPay1="Private";
  if (Pay1=4) or (Pay1=5) then nPay1="Other";
  if (age<=4) then grAge = "1";
  if (age >= 5) and (age <=9) then grAge = "2";
  if (age >= 10) and (age <=14) then grAge = "3";
  if (age >= 15) and (age <=18) then grAge = "4";
  if (age >= 19) and (age <=20) then grAge = "5";
run;

data allcombined2000;
  set allffracture2000
  k2000 (IN=Inhosp keep=hospid kid_stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
    pay1=0;
    race=0;
    age=0;
    female=0;
    NDX=0;
  end;
end;
run;
PROC SURVEYM EANS DATA=ALLCOMBINED2000;
WEIGHT DISCW T;
CLUSTER HOSPID;
STRATA KID_STRATUM;
VAR DISCHGS LOS TOTCHG NDX;
DOMAIN INSUBSET;
RUN;
PROC TTEST DATA=ALLFEMURCANCER2000 H0=18048;
VAR TOTCHG;
RUN;
PROC TTEST DATA=ALLFEMURCANCER2000 H0=12.751;
VAR AGE;
RUN;
DATA FEMURCANCERALL2000;
SET K2000;
IF DX1 IN ("1707") OR DX2 IN ("1707") THEN CANCER = 1; ELSE CANCER = 0;
RUN;
PROC SURVEYFREQ DATA=FEMURCANCERALL2000;
WEIGHT DISCW T;
STRATUM KID_STRATUM;
CLUSTER HOSPID;
TABLE CANCER/C1;
RUN;
*********** Imputed **********************;
DATA FRACTURE2000;
SET K2000;
IF DX1 IN ("1707");
IF (AGE <= 18);
DISCHGS = 1;
RUN;
PROC MI NIMPUTE=0 DATA=FRACTURE2000;
VAR LOS AGE FEMALE NDX TOTCHG RACE PAY1;
RUN;
PROC MI DATA=FRACTURE2000 NIMPUTE=10 SEED=333 OUT=OUTFRACTUREFULL2000;
CLASS PAY1 RACE;
FCS REG (TOTCHG=LOS AGE FEMALE NDX);
FCS DISCRIM (RACE=LOS AGE NDX TOTCHG);
FCS DISCRIM (PAY1=LOS AGE NDX TOTCHG);
VAR LOS AGE FEMALE NDX TOTCHG RACE PAY1;
RUN;
DATA FEMURCANCER2000;
SET OUTFRACTUREFULL2000;
DISCHGS = 1;
RUN;
DATA COMBINED2000;
set FemurCancer2000
k2000.KID_2000_Core (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;

proc surveymeans data=combined2000;
weight discwt;
cluster hospid;
strata kid_stratum;
var dischgs LOS age female NDX totchg race Pay1;
domain insubset;
ods output domain=comb2000;
run;

proc mianalyze data=comb2000;
modeleffects mean;
stderr stderr;
run;

2003
proc import datafile='C:\Users\childstr\Desktop\CCR2003.xlsx' out=work.CCRI dbms=xlsx replace;
run;
DATA k12003;
set k2003.KID_2003_CORE;
run;
DATA k22003;
set k2003.KID_2003_hospital;
run;
data k32003;
set k2003.KID_2003_SEVERITY;
run;
data k2003;
merge k12003 k22003 k32003 work.CCRI;
by hospid;
run;

proc contents data=k2003 varnum;
**Missing Data***********

```plaintext
data femurCancer2003;
  set k2003;
  if DX1 in ("1707");
  DISCHGS = 1;
  if (race=1) then nrace="White";
  if (race=2) then nrace="Black";
  if (race=3) then nrace="Hispanic";
  if (race=4) or (race=5) or (race=6) then nrace="Other";
  if (Pay1=1) or (Pay1=2) then nPay1="Public";
  if (Pay1=3) then nPay1="Private";
  if (Pay1=4) or (Pay1=5) then nPay1="Other";
  if (age<=4) then grAge = "1";
  if (age >= 5) and (age <=9) then grAge = "2";
  if (age >= 10) and (age <=14) then grAge = "3";
  if (age >= 15) and (age <=18) then grAge = "4";
  if (age>=19) and (age<=20) then grage ="5";
run;

data combined2003;
  set FemurCancer2003
  k2003 (IN=Inhosp keep=hospid kid_stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
  end;
run;

proc surveymeans data=combined2003 sum std mean stderr;
  weight discwt;
  class race pay1 female;
  cluster hospid;
  strata kid_stratum;
  var dischgs LOS Totchg NDX nRACE nPAY1 Female AGE;
  domain insubset;
run;

proc ttest data=femurcancer2003 h0=2626.65;
  var Totchg;
run;
proc ttest data=femurcancer2003 h0=13.84;
  var age;
run;
data femurCancer2003;
  set k2003;
  if DX1 in ("1707") then cancer=1; else cancer=0;
```
run;

proc surveyfreq data=femurcancer2003;
  weight discwt;
  stratum kid_stratum;
  cluster hospid;
  table cancer/cl;
run;

data allffracture2003;
  set k2003;
  if DX1 in ("1707") or DX2 in ("1707");
    DISCHGS = 1;
  if (race=1) then nrace="White";
  if (race=2) then nrace="Black";
  if (race=3) then nrace="Hispanic";
  if (race=4) or (race=5) or (race=6) then nrace="Other";
  if (Pay1=1) or (Pay1=2) then nPay1="Public";
  if (Pay1=3) then nPay1="Private";
  if (Pay1=4) or (Pay1=5) then nPay1="Other";
  if (age<=4) then grAge = "1";
  if (age >= 5) and (age <= 9) then grAge = "2";
  if (age >= 10) and (age <= 14) then grAge = "3";
  if (age >= 15) and (age <= 18) then grAge = "4";
  if (age>=19) and (age<=20) then grage ="5";
run;

data allcombined2003;
  set allffracture2003
    k2003 (IN=Inhosp keep=hospid kid_stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
  end;
run;
proc surveymeans data=allcombined2003 sum std mean stderr;
  weight discwt;
  class nrace npay1 female;
  cluster hospid;
  strata kid_stratum;
  var dischgs LOS Totchg NDX nRACE nPay1 female AGE;
  domain insubset;
run;
proc ttest data=allfemurcancer2003 h0=25876;
  var Totchg;
run;
```plaintext
proc ttest data=allfemurcancer2003 h0=13.82;
  var age;
run;
data femurCancerall2003;
  set k2003;
  if DX1 in ("1707") or DX2 in ("1707") then cancer=1; else cancer=0;
run;
proc surveyfreq data=femurcancerall2003;
  weight discwt;
  stratum kid_stratum;
  cluster hospid;
  table cancer/cl;
run;
**********Imputed*************;
data ffracture2003;
  set k2003;
  if DX1 in ("1707");
  if (age<=18);
    DISCHGS = 1;
run;
proc mi nimpute=0 data=ffracture2003;
  var LOS NDX Pay1 Totchg age female race;
run;
proc mi data=ffracture2003 nimpute=10 seed=333 out=outfracture2003;
  class female race;
  fcs reg (totchg=LOS NDX Pay1);
  fcs reg (age=LOS NDX Pay1 Totchg);
  fcs logistic (female=LOS NDX Pay1 Totchg age);
  fcs discrim (race=LOS NDX Totchg age);
  var LOS NDX Pay1 Totchg age female race;
run;
data FemurCancer2003;
  set outfracture2003;
  DISCHGS = 1 ;
run;
data combined2003;
  set FemurCancer2003
    k2003.KID_2003_Core (IN=Inhosp keep=hospid kid_stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
```

pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;

proc surveymeans data=combined2003;
weight discwt;
cluster hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX female race pay1;
domain insubset;
ods output domain=comb2003;
run;
proc mi nimpate=0 data=allfracture2003;
var LOS NDX Pay1 Totchg age female race;
run;
proc mi data=allfracture2003 nimpate=10 seed=555 out=allfracture2003;
class female race pay1;
fcs discrim (Pay1=LOS NDX/details);
fcs reg (Totchg=LOS NDX Pay1/details);
fcs reg (Age=LOS NDX Pay1 Totchg/details);
fcs logistic (Female=LOS NDX Pay1 Totchg Age/details);
fcs discrim (race=LOS NDX Totchg Age/details);
var LOS NDX Pay1 Totchg age female race;
run;

data allFemurCancer2003;
set alloutfracture2003;
DISCHGS = 1;
run;
data allcombined2003;
set allFemurCancer2003
k2003 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
if (age<=18);
if DX1 in ("1707") or DX2 in ("1707");
DISCHGS = 1;
run;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;
proc surveymeans data=allcombined2003;
weight discwt;
cluster hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX;
domain insubset;
ods output domain=comb2003;
run;
proc mianalyze data=comb2003;
modeleffects mean;
stderr stderr;
run;
2006
proc import datafile='C:\Users\childstr\Desktop\CCR2006.xlsx' out=work.CCRI
dbms=xlsx replace;
run;
DATA k12006;
set k2006.KID_2006_CORE;
run;
DATA k22006;
set k2006.KID_2006_hospital;
run;
Data k32006;
set k2006.KID_2006_Severity;
run;
data k2006;
merge k12006 k22006 k32006 work.CCRI;
by hospid;
run;
options missing=" ";
data All_FC2006;
set k2006;
if DX1 in("1707") or DX2 in("1707") or DX3 in("1707") or DX4 in("1707") or
DX5 in("1707") or DX6 in("1707") or DX7 in("1707") or DX8 in("1707") or
DX9 in("1707") or DX10 in("1707") or DX11 in("1707") or DX12 in("1707") or
DX13 in("1707") or DX14 in("1707") or DX15 in("1707") or DX16 in("1707") or
DX17 in("1707") or DX18 in("1707") or DX19 in("1707") or DX20 in("1707") or
DX21 in("1707") or DX22 in("1707") or DX23 in("1707") or DX24 in("1707") or
DX25 in("1707");
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >= 10) and (age <=14) then grAge = "3";
if (age >= 15) and (age <=18) then grAge = "4";
run;
ods listing close;
ods csv file='C:\Users\childstr\Desktop\ALLFC2006.csv';
proc print data=All_FC2006 noobs;
title;
run;
ods csv close;
do listing;
run;
quit;

proc contents data=k2006.KID_2006_Core varnum;
run;

****Missing Data***********;
data femurCancer2006;
  set k2006;
  if DX1 in ("1707");
  DISCHGS = 1;
  if hospbrth=0;
  if (race=1) then nrace="White";
  if (race=2) then nrace="Black";
  if (race=3) then nrace="Hispanic";
  if (race=4) or (race=5) or (race=6) then nrace="Other";
  if (Pay1=1) or (Pay1=2) then nPay1="Public";
  if (Pay1=3) then nPay1="Private";
  if (Pay1=4) or (Pay1=5) then nPay1="Other";
  if (age<=4) then grAge = "1";
  if (age >= 5) and (age <=9) then grAge = "2";
  if (age >= 10) and (age <=14) then grAge = "3";
  if (age >= 15) and (age <=18) then grAge = "4";
  if (age>=19) and (age<=20) then grage ="5";
run;
data combined2006;
  set FemurCancer2006
  k2006 (IN=Inhosp keep=hospid kid_stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
  end;
end;
proc surveymeans data=femurcancer2006 sum std mean stderr;
weight discwt;
cluster hospid;
strata kid_stratum;
var LOS Totchg NDX RACE PAY1 Female AGE;
run;

*****p value*****;
data k2006ii;
  set k2006;
if hospbirth=0;
  if (age<= 18);
    if (race=1) then nrace="White";
    if (race=2) then nrace="Black";
    if (race=3) then nrace="Hispanic";
    if (race=4) or (race=5) or (race=6) then nrace="Other";
    if (Pay1=1) or (Pay1=2) then nPay1="Public";
    if (Pay1=3) then nPay1="Private";
    if (Pay1=4) or (Pay1=5) then nPay1="Other";
    if (age<= 4) then grAge = "1";
    if (age >= 5) and (age <= 9) then grAge = "2";
    if (age >= 10) and (age <= 14) then grAge = "3";
    if (age >= 15) and (age <= 18) then grAge = "4";
run;
proc surveyfreq data=k2006ii;
weight discwt;
cluster hospid;
strata kid_stratum;
table female grage nPay1;
run;
proc ttest data=femurcancer2006 h0= 76206;
var Totchg;
run;
proc ttest data=femurcancer2006 h0=13.37;
var age;
run;
data femurCancer2006;
  set k2006;
  if DX1 in ("1707") then cancer=1; else cancer=0;
run;
proc surveyfreq data=femurcancer2006;
weight discwt;
stratum kid_stratum;
cluster hospid;
table cancer/cl;
run;
data allffracture2006;
set k2006;
if DX1 in ("1707") or DX2 in ("1707");
DISCHGS = 1;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <= 9) then grAge = "2";
if (age >= 10) and (age <= 14) then grAge = "3";
if (age >= 15) and (age <= 18) then grAge = "4";
if (age>=19) and (age<=20) then grage = "5";
run;

data allcombined2006;
set allffracture2006
k2006 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;
proc surveymeans data=allcombined2006 sum std mean stderr;
weight discwt;
class nrace npay1 female;
cluster hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX nRACE nPay1 female AGE;
domain insubset;
run;
proc ttest data=allfemurcancer2006 h0=34139;
var Totchg;
run;
proc ttest data=allfemurcancer2006 h0=13.31;
var age;
run;
data femurCancerall2006;
set k2006;
if DX1 in ("1707") or DX2 in ("1707") then cancer=1; else cancer=0;
run;
proc surveyfreq data=femurCancerall2006;
weight discwt;
stratum kid_stratum;
class hospid;
table cancer/cl;
run;
***************Imputed*******************************;
data ffracture2006;
set k2006;
if DX1 in ("1707");
if (age<=18);
DISCHGS = 1;
run;

proc mi nimpute=0 data=ffracture2006;
var LOS NDX Pay1 age Totchg female race;
run;

proc mi data=ffracture2006 nimpute=10 seed=676 out=outfracture2006;
class female Pay1 race;
fcs reg (age=LOS NDX Pay1/details);
fcs reg (totchg=LOS NDX Pay1 age/details);
fcs logistic (female=LOS NDX Pay1 age totchg/details);
fcs discrim (race=LOS NDX age Totchg/details);
var LOS NDX Pay1 age Totchg female race;
run;

data FemurCancer2006;
set outfracture2006;
DISCHGS = 1 ;
run;
data combined2006;
set FemurCancer2006
k2006 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;
proc surveymeans data=combined2006;
weight discwt;
class hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX female race pay1;
domain insubset;
ods output domain=comb2006;
run;
proc mianalyze data=comb2006;
model effects mean;
stderr stderr;
run;
data allffracture2006;
set k2006;
if (age<=18);
  if DX1 in ("1707") or DX2 in ("1707");
  dischgs = 1;
run;
proc mi nimpute=0 data=allffracture2006;
var LOS NDX Pay1 age Totchg female race;
run;
proc mi data=allffracture2006 nimpute=10 seed=777 out=alloutfracture2006;
class Pay1 female race;
fcs reg (age=LOS NDx pay1);
fcs reg (Totchg=LOS NDX Pay1 age);
fcs logistic (Female=LOS NDX Pay1 age Totchg);
fcs discrim (race= LOS NDX age Totchg);
var LOS NDX Pay1 age Totchg female race;
run;
data allFemurCancer2006;
  set alloutfracture2006;
  dischgs = 1 ;
run;
data allcombined2006;
  set allFemurCancer2006 k2006 (IN=Inhosp keep=hospid kid_stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
    died=0;
    dischgs=0;
    LOS=0;
    Totchg=0;
    pay1=0;
    race=0;
    age=0;
    female=0;
    NDX=0;
  end;
run;
proc surveymeans data=allcombined2006;
weight discwt;
cluster hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX;
domain insubset;
ods output domain=comb2006;
run;
proc mianalyze data=comb2006;
modeleffects mean;
stderr stderr;
run;
2009
proc import datafile='C:\Users\childstr\Desktop\CCR2009.xlsx' out=work.CCRIII
dbms=xlsx replace;
run;
DATA k12009;
set kidd.KID_2009_CORE;
run;
DATA k22009;
set kidd.KID_2009_hospital;
run;
DATA k32009;
set kidd.KID_2009_Severity;
run;
data k2009;
merge k12009 k22009 k32009 work.CCRIII;
by hospid;
run;
proc contents data=k2009 varnum;
run;
****Missing Data***********;
data femurCancer2009;
set k2009;
if DX1 in ("1707");
DISCHGS = 1;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >= 10) and (age <=14) then grAge = "3";
if (age >= 15) and (age <=18) then grAge = "4";
if (age>=19) and (age<=20) then grage ="5";
if PR1 in ("7735", "7765", "7785", "7787", "7795", "7805", "7825", "7835", "7855", "7935") then group = 0;
if PR1 in ("8410", "8415", "8416", "8417", "8418", "8419") then Group = 1;
run;

data combined2009;
set FemurCancer2009 k2009 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;
proc surveymeans data=femurcancer2009;
weight discwt;
cluster hospid;
strata kid_stratum;
var LOS Totchg NDX RACE PAY1 Female AGE;
run;
*****p value*****;
data k2009ii;
set k2009;
if (age<=18);
if hospbrth=0;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >= 10) and (age <=14) then grAge = "3";
if (age >= 15) and (age <=18) then grAge = "4";
run;
proc surveyfreq data=k2009ii;
weight discwt;
cluster hospid;
strata kid_stratum;
table female grage nPay1;
run;

proc surveymeans data=k2009ii;
weight discwt;
cluster hospid;
strata kid_stratum;
var LOS;
run;

proc logistic data=combined2009;
class female nrace npay1/param=ref;
model group (event='1') = female nrace nPAY1 age NDX;
run;

data femurCancer2009;
set k2009;
if DX1 in ("1707") then cancer=1; else cancer=0;
run;

proc surveyfreq data=femurCancer2009;
weight discwt;
stratum kid_stratum;
cluster hospid;
table cancer/cl;
run;

data femurCancer2009amp;
set k2009;
if DX1 in ("1707");
DISCHGS = 1;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <= 9) then grAge = "2";
if (age >= 10) and (age <= 14) then grAge = "3";
if (age >= 15) and (age <= 18) then grAge = "4";
if (age>=19) and (age<=20) then grage ="5";
if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =1;else group=0;
run;

data combined2009amp;
set FemurCancer2009amp
k2009 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;
**proc surveymeans** data=combined2009amp sum std mean stderr;
  weight discwt;
  class nrace pay1 female;
  cluster hospid;
  strata kid_stratum;
  var dischgs LOS Totchg NDX nRACE nPAY1 Female AGE;
  domain insubset;
run;

**proc logistic** data=combined2009amp;
  class female nrace npay1/param=ref;
  model group (event='1') = female nrace nPAY1 age NDX;
run;

**proc ttest** data=femurcancer2009 h0=92606;
  var Totchg;
run;

**proc ttest** data=femurcancer2006 h0=13.37;
  var age;
run;

data allffracture2009;
set k2009;
  if DX1 in ("1707") or DX2 in ("1707");
    DISCHGS = 1;
  if (race=1) then nrace="White";
  if (race=2) then nrace="Black";
  if (race=3) then nrace="Hispanic";
  if (race=4) or (race=5) or (race=6) then nrace="Other";
  if (Pay1=1) or (Pay1=2) then nPay1="Public";
  if (Pay1=3) then nPay1="Private";
  if (Pay1=4) or (Pay1=5) then nPay1="Other";
  if (age<=4) then grAge = "1";
  if (age >= 5) and (age <= 9) then grAge = "2";
  if (age >= 10) and (age <= 14) then grAge = "3";
  if (age >= 15) and (age <= 18) then grAge = "4";
  if (age>=19) and (age<=20) then grage ="5";
run;

data allcombined2009;
set allffracture2009
  k2009 (IN=Inhosp keep=hospid kid_stratum);
  insubset=1;
  if inhosp then do;
    insubset=2;
    discwt=1;
  died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;

proc surveymeans data=allcombined2009 sum std mean stderr;
weight discwt;
class nrace npay1 female;
cluster hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX nRACE nPay1 female AGE;
domain insubset;
run;

proc ttest data=allfemurcancer2009 h0=13.44;
var age;
run;

data femurCancerall2009;
set k2009;
  if DX1 in ("1707") or DX2 in ("1707") then cancer=1; else cancer=0;
run;

proc surveyfreq data=femurcancerall2009;
weight discwt;
stratum kid_stratum;
cluster hospid;
table cancer/cl;
run;

***************Imputed***************************;

data ffracture2009;
set k2009;
  if DX1 in ("1707");
  if (age<=18);
  DISCHGS = 1;
run;

proc mi nimpute=0 data=ffracture2009;
var LOS NDX Pay1 Totchg age female race;
run;

proc mi data=ffracture2009 nimpute=10 seed=333 out=outfracturefull2009;
class race female;
fcs discrim (race=LOS NDX Totchg age/details);
fcs logistic (female=LOS NDX Pay1 Totchg age/details);
fcs reg (Totchg=LOS NDX Pay1/details);
fcs reg(age=LOS NDX PAY1 Totchg/details);
var LOS NDX Pay1 Totchg age female race;
run;

data FemurCancer2009;
set outfracturefull2009;
  DISCHGS = 1;
run;

data combined2009;
set FemurCancer2009
k2009 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
NDX=0;
female=0;
end;
run;
proc surveymeans data=combined2009;
weight discwt;
cluster hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX race female pay1 age;
domain insubset;
ods output domain=comb2009 close;
run;
proc mianalyze data=comb2009;
modeleffects mean;
stderr stderr;
run;
data allffracture2009;
set k2009;
if DX1 in ("1707") or DX2 in ("1707");
if (age<= 18);
DISCHGS = 1;
run;
proc mi nimpute=0 data=allffracture2009;
var LOS NDX Pay1 Totchg age female race;
run;
proc mi nimpute=10 data=allffracture2009 seed=8888 out=alloutfracturefull2009;
class female Pay1 race;
fcs discrim (race=LOS NDX Totchg age/details);
fcs logistic (female=LOS NDX Pay1 Totchg age/details);
fcs reg (Totchg=LOS NDX Pay1/details);
fcs reg(age=LOS NDX PAY1 Totchg/details);
var LOS NDX Pay1 Totchg age female race;
run;
data allFemurCancer2009;
set alloutfracturefull2009;
DISCHGS = 1;
run;
data allcombined2009;
set allfemurcancer2009
k2009 (IN=Inhosp keep=hospid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;
proc surveymeans data=allcombined2009;
weight discwt;
cluster hospid;
strata kid_stratum;
var dischgs LOS Totchg NDX;
domain insubset;
ods output domain=allcomb2009;
run;
proc mianalyze data=allcomb2009;
modeleffects mean;
stderr stderr;
run;
2012
proc contents data=k2012.KID_2012_core varnum;
run;
proc import datafile='C:\Users\childstr\Desktop\CCR2012.xlsx' out=work.CCRIV
dbms=xlsx replace;
run;
DATA k12012;
set k2012.KID_2012_CORE;
run;
DATA k22012;
set k2012.KID_2012_hospital;
run;
DATA k32012;
set k2012.KID_2012_Severity;
run;
data k2012;
merge k12012 k22012 k32012 work.CCRIV;
by hosp_kid;
run;
******DX1-DX25******;
options missing=" " ;
data All_FC2012;
set k2012;
if DX1 in("1707") or DX2 in("1707") or DX3 in("1707") or DX4 in("1707") or
DX5 in("1707") or DX6 in("1707") or DX7 in("1707") or DX8 in("1707") or
DX9 in("1707") or DX10 in("1707") or DX11 in("1707") or DX12 in("1707") or
DX13 in("1707") or DX14 in("1707") or DX15 in("1707") or DX16 in("1707") or
DX17 in("1707") or DX18 in("1707") or DX19 in("1707") or DX20 in("1707") or
DX21 in("1707") or DX22 in("1707") or DX23 in("1707") or DX24 in("1707") or
DX25 in("1707"));
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >=10) and (age <=14) then grAge = "3";
if (age >=15) and (age <=18) then grAge = "4";
run;
ods listing close;
ods csv file='C:\Users\Tawanna\Desktop\ALLFC2012.csv';
proc print data=All_FC2012 noobs;
title;
run;
ods csv close;
ods listing;
run;
quit;

****Missing Data************;
data femurCancer2000;
set k2000;
if DX1 in ("1707") or DX2 in ("1707") then cancer=1; else cancer=0;
if (age<=18);
if HOSPBRTH=0; **represents all other pediatric cases that are complicated and not births***;
if PR1 in ("7735", "7765", "7785", "7787", "7795", "7805", "7825", "7835", "7855",
"7935", "8410", "8415", "8416", "8417", "8418", "8419") then Group =1; else group=0;
run;
Proc surveyfreq data=femurcancer2000;
stratum kid_stratum;
cluster hospid;
weight discwt;
table cancer/cl;
run;
data femurCancer2012;
set k2012;
if DX1 in ("1707");
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if PR1 in ("7735", "7765", "7785", "7787", "7805", "7825", "7835", "7855",
"7935", "8410", "8415", "8416", "8417", "8418", "8419") then Group =1; else group=0;
run;
data combined2012;
set FemurCancer2012
k2012 (IN=lnhosp keep=hosp_kid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischg=0;
LOS=0;
Totchg=0;
end;
run;
proc surveymeans data=femurcancer2012 sum std mean stderr;
weight discwt;
cluster hosp_kid;
strata kid_stratum;
var LOS Totchg NDX RACE PAY1 Female AGE;
run;
***pvalue***;
data k2012ii;
set k2012;
if hospbrth=0;
if (age<=18);
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age<=4) then grAge = "1";
if (age >= 5) and (age <=9) then grAge = "2";
if (age >= 10) and (age <=14) then grAge = "3";
if (age >= 15) and (age <=18) then grAge = "4";
run;
proc surveyfreq data=k2012ii;
weight discwt;
cluster hosp_kid;
strata kid_stratum;
table female grage npay1;
run;

proc surveymeans data=k2012ii;
weight discwt;
cluster hosp_kid;
strata kid_stratum;
var LOS;
run;

proc surveymeans data=comb2012;
weight discwt;
cluster hospid;
strata kid_stratum;
var LOS Totchg NDX age;
domain insubset;
run;
proc ttest data=femurcancer2012 h0=107022;
var Totchg;
run;
proc surveyfreq data=comb2012;
weight discwt;
stratum kid_stratum;
cluster hosp_kid;
table npay1/cl;
run;
proc freq data=femurcancer2012;
tables npay1/chisq testp=(3.46 60.77 35.77);
run;

data femurCancer2012amp;
set k2012;
if DX1 in ("1707");
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
if (age >= 0) and (age <=18) then grAge = "0-18";
if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =1; else group=0;
run;

data combined2012amp;
set FemurCancer2012amp
k2012 (IN=Inhosp keep=hosp_kid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;
**proc surveymeans** data=combined2012amp;
weight discwt;
class race pay1 female;
cluster hosp_kid;
strata kid_stratum;
var dischgs LOS Totchg NDX nRACE nPAY1 Female AGE;
domain insubset;
run;

**data** femurCancer2012amp;
set k2012;
if DX1 in ("1707") then cancer=1; else cancer=0;
if (age >= 0) and (age <= 18) then grAge = "0-18";
if PR1 in ("7735", "7765", "7785", "7787", "7805", "7825", "7835", "7855", "7935") then Group = 1; else group=0;
run;
**proc surveyfreq** data=femurcancer2012amp;
weight discwt;
stratum kid_stratum;
cluster hosp_kid;
table group*grage*cancer/cl;
run;

**data** allffracture2012;
set k2012;
if DX1 in ("1707") or DX2 in ("1707");
DISCHGS = 1;
if (race=1) then nrace="White";
if (race=2) then nrace="Black";
if (race=3) then nrace="Hispanic";
if (race=4) or (race=5) or (race=6) then nrace="Other";
if (Pay1=1) or (Pay1=2) then nPay1="Public";
if (Pay1=3) then nPay1="Private";
if (Pay1=4) or (Pay1=5) then nPay1="Other";
run;

**data** allcombined2012;
set allffracture2012
k2012 (IN=Inhosp keep=hosp_kid kid_stratum);
insubset=1;
if inhosp then do;
  insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
end;
run;
**proc surveymeans** data=allcombined2012 sum std mean stderr;
weight discwt;
class nrace npay1 female;
cluster hosp_kid;
strata kid_stratum;
var dischgs LOS Totchg NDX nRACE nPay1 female AGE;
domain insubset;
run;

proc ttest data=allfemurcancer2012 h0=40816;
var Totchg;
run;
proc ttest data=allfemurcancer2012 h0=13.23;
var age;
run;

data allfemurCancer1997ampl;
set k1997;
if DX1 in ("1707") or DX2 in ("1707") then cancer=1; else cancer=0;
if (age >= 0) and (age <= 18) then grAge = "0-18";
if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =1; else group=0;
run;
proc surveyfreq data=allfemurcancer1997ampl;
weight discwt;
stratum stratum;
cluster hospnum;
table grage*cancer/cl;
run;

*****
Imputed

*****

proc surveyfreq data=allfemurcancer1997ampl;
weight discwt;
stratum stratum;
class race Pay1;
table cancer race group/chi;
run;

data ffracture2012;
set k2012;
if (age<=18);
if DX1 in ("1707");
DISCHGS = 1;
run;

proc mi ninput=0 data=ffracture2012;
var LOS age female NDX Pay1 race totchg;
run;
proc mi ninput=10 data=ffracture2012 seed=987 out=outfracture2012;
class race Pay1;
fcs discrim (Pay1=LOS NDX age);
fcs discrim (race=LOS NDX age);
fcs reg (totchg=LOS age NDX Pay1 race/details);
var LOS age NDX Pay1 race Totchg;
run;

data FemurCancer2012;
set outfracture2012;
DISCHGS = 1;
run;
data combined2012;
set FemurCancer2012 k2012 (IN=Inhosp keep=hosp_kid kid_stratum);
insubset=1;
if inhosp then do;
insubset=2;
discwt=1;
died=0;
dischgs=0;
LOS=0;
Totchg=0;
pay1=0;
race=0;
age=0;
female=0;
NDX=0;
end;
run;
proc surveymeans data=combined2012;
weight discwt;
cluster hosp_kid;
strata kid_stratum;
var dischgs AGE LOS Totchg NDX Pay1 race;
domain insubset;
ods output domain=comb2012;
run;
proc mianalyze data=comb2012;
modeleffects mean;
stderr stderr;
run;
data allffracture2012;
set k2012;
if (age<=18);
if DX1 in ("1707") or DX2 in ("1707");
DISCHGS = 1;
run;
proc mi nimpute=0 data=allffracture2012;
var LOS female NDX age Pay1 race totchg;
run;
proc mi data=allffracture2012 nimpute=10 seed=333 out=alloutfracturefull2012;
class race Pay1;
fcs reg (age=LOS Female NDX);
fcs discrim (Pay1=LOS NDX age);
fcs discrim (race=LOS NDX age);
fcs reg (totchg=LOS age NDX Pay1 race/details);
var LOS age NDX Pay1 race Totchg female;
run;
data allFemurCancer2012;
set alloutfracturefull2012;
DISCHGS = 1;
run;
data allcombined2012;
set allFemurCancer2012 k2012.KID_2012_Core (IN=Inhosp keep=hosp_kid kid_stratum);
insubset=1;
if inhosp then do;
  insubset=2;
  discwt=1;
  died=0;
  dischgs=0;
  LOS=0;
  Totchg=0;
  pay1=0;
  race=0;
  age=0;
  female=0;
  NDX=0;
end;
run;
proc surveymeans data=allcombined2012;
weight discwt;
cluster hosp_kid;
strata kid_stratum;
var dischgs LOS Totchg NDX;
domain insubset;
ods output domain=allcomb2012;
run;
proc mianalyze data=allcomb2012;
modeleffects mean;
stderr stderr;
run;
data combproc1997;
set ffracture1997;
if PR1 in ("7735") then Procedure="Removal of Articulation End of Bone";
if PR1 in ("7765") then Procedure="Local Excision";
if PR1 in ("7785") then Procedure="Partial Ostectomy Right Femur";
if PR1 in ("7787") then Procedure="Partial Ostectomy Tibia";
if PR1 in ("7795") then Procedure="Total Ostectomy Femur";
if PR1 in ("7805") then Procedure="Bone Graft Femur";
if PR1 in ("7825") then Procedure="Limb Shortening Procedures";
if PR1 in ("7835") then Procedure="Limb Lengthening Procedures";
if PR1 in ("7855") then Procedure="Internal Fixation";
if PR1 in ("7935") then Procedure="Open Reduction";
if PR1 in ("8410") then Procedure="Lower Limb Amputation";
if PR1 in ("8415") then Procedure="Amputation Below Knee";
if PR1 in ("8416") then Procedure="Disarticulation Knee";
if PR1 in ("8417") then Procedure="Disarticulation Hip";
if PR1 in ("8419") then Procedure="Abdominopelvic Amputation";
if (sex=1) then Gender="Male";
if (sex=2) then Gender=" Female ";
if (female=0) then Gender="Male";
if (female=1) then Gender=" Female ";
if (age >= 0) and (age <= 4) then Ages ="0-4";
if (age >= 5) and (age <= 9) then Ages ="5-9";
if (age >= 10) and (age <= 14) then Ages ="10-14 ";
if (age >= 15) and (age <= 18) then Ages ="15-18 ";
run;

Goptions reset=all ftext='Arial/bo' cback=white ctext=black htext=2;
Pattern value=solid color=blue;
proc gchart data=combproc1997;
hbar Procedure/ discrete type=percent nostat descending
subgroup=Gender;
title 'Femur Cancer Discharges with Femur/Hip Procedures in 1997';
run;
quit;

******Normality for the variables age, totchg, LOS and NDX**********;
proc univariate data=ffracture1997 plots normal;
var totchg;
run;


******Trend Analysis***************;
proc import datafile='C:\Users\Tawanna\Desktop\FC2000iin.xlsx' out=work.FC2000iin
dbms=xlsx replace;
run;

Data transform2000;
set work.FC2000iin;
STDEVAFI=SQRT(STDEVAF);
STDEVAFII=LOG10(STDEVAF);
PopulationI=SQRT(Population);
PopulationII=LOG10(Population);
NDXI=SQRT(NDX);
NDXII=LOG10(NDX);
STDEVFI=SQRT(STDEVF);
STDEVFII=LOG10(STDEVF);
STDEVDI=SQRT(STDEVD);
STDEVDI=LOG10(STDEVD);
STDEVAMPI=sqrt(STDEVAMP);
STDEVAMPII=log10(STDEVAMP);
stdevGI=log10(stdevG);
stdevGII=sqrt(stdevG);
run;

proc reg data=fc2000iin;
title "Simple Linear Regression of Pediatric Population Vs. Discharges";
model discharges=population/r cli clm;
run;
quit;
proc reg data=work.FC2000iin;
title "Simple Linear Regression of Pediatric Population Vs. Primary/Secondary Femur Cancer";
model AllFC=population/p;
run;
quit;
proc reg data=work.FC2000iin;
title "Simple Linear Regression of Pediatric Population Vs. Primary Femur Cancer";
model FC=population/p;
run;
quit;
proc reg data=fc2009ii;
title "Simple Linear Regression of Pediatric Population Vs. NDX";
model NDX=population/p;
run;
quit;
proc reg data=fc2000iin;
title "Simple Linear Regression of Pediatric Population Vs. Discharges";
model discharges=population/r cli clm;
run;
quit;
proc reg data=work.FC2000iin;
title "Simple Linear Regression of Pediatric Population Vs. Primary/Secondary Femur Cancer";
model AllFC=population/p;
run;
quit;
proc reg data=work.FC2000iin;
title "Simple Linear Regression of Pediatric Population Vs. Primary Femur Cancer";
model FC=population/p;
run;
quit;

*****work.FC2003ii,work.FC2006ii,work.FC2009ii datasets***********;
*******Linear Regression of the years 2000-2009**********;
proc reg data=transform2000;
title "Simple Linear Regression of Pediatric Population Vs. STDEV Discharges 2000";
model STDEVD=Population/r cli clm;
run;
quit;
proc reg data=transform2000;
title "Simple Linear Regression of Pediatric Population Vs. STDEV Primary/Secondary Femur Cancer";
model STDEVAF=Population/p;
run;
quit;
proc reg data=transform2000;
title "Simple Linear Regression of Pediatric Population Vs. STDEV Femur Cancer";
model STDEVF=Population/p;
run;
quit;

*******transform2003,transform2006, transform2009****;
*****Linear Regression of the standard deviation of the years 2000-2009****;

*****cluster=hospnum and stratum=stratum and female=sex for 1997 and cluster=hosp_kid for 2012**************;

****Total Discharges*******;

`proc import datafile='C:\Users\willi5ad\Desktop\Trend_Analysis.xlsx' out=work.Discharges dbms=xlsx replace;`
`run;`
`data Discharges; set work.discharges; LCL=(Pediatric_Non_Births-StdevD); UCL=(Pediatric_Non_Births+StdevD); phat=(13096513/620971906); x1=Pediatric_Non_Births/Population; u1=((x1-phat)/STERRD)*((x1-phat)/STERRD); run;`
`proc print data=Discharges; sum Pediatric_Non_Births; sum population; sum u1; run;`
`title;`
`proc template; define style styles.blue; parent=styles.default; class GraphColors "Abstract colors used in graph styles"/ 'gdata'=cxaFb3cF 'gdata3'=cx8CaEdF 'gdata2'=cx5A96DE 'gdata1'=cx42659C; style color_list from color_list "Abstract colors used in graph styles"/ 'bgA'=cxe0e7e7; end; run;`
`proc template; define statgraph myBchart; begingraph; entrytitle 'Pediatric_Non_Births (2000-2009)'; layout overlay / xaxisopts=(type=discrete) yaxisopts=(type=Linear); barchart x=year y=Pediatric_Non_Births/ stat=sum; scatterplot x=year y=Pediatric Non_Births/ markerattrs=(size=0) yerrorlower=LCL yerrorupper=UCL; endlayout; endgraph; end; run; PROC SGRNDER DATA=Discharges TEMPLATE=myBchart; RUN;`
****All FC****;

data All_Femur_Cancer;
set work.discharges;
LCL=(Femur_Cancer-StdevAF);
UCL=(Femur_Cancer+StdevAF);
run;
proc print data=work.discharges;
run;
proc template;
define statgraph myBchart;
begingraph;
entrytitle 'Primary/Secondary Femur Cancer Discharges (2000-2009)';
layout overlay / xaxisopts=(type=discrete) yaxisopts=(type=Linear);
barchart x=year y=Femur_Cancer/ stat=sum;
scatterplot x=year y=Femur_Cancer/
markerattrs=(size=0) yerrorlower=LCL yerrorupper=UCL; endlayout; endgraph; end; run;
PROC SGRENDER
DATA=All_Femur_Cancer TEMPLATE=myBchart;
RUN;

data All_Femur_Cancer;
set work.discharges;
LCL=(Femur_Cancer-StdevAF);
UCL=(Femur_Cancer+StdevAF);
run;
proc print data=work.discharges;
run;
proc template;
define statgraph myBchart;
begingraph;
entrytitle 'Percent Primary/Secondary Femur Cancer Discharges to Non-Births (2000-2009)';
layout overlay / xaxisopts=(type=discrete) yaxisopts=(type=Linear);
barchart x=year y=Per_AFC/ stat=sum;
scatterplot x=year y=PerAFC/
markerattrs=(size=0) yerrorlower=None yerrorupper=None; endlayout; endgraph; end; run;
PROC SGRENDER
DATA=All_Femur_Cancer TEMPLATE=myBchart;
RUN;

**************Femur Cancer**************;

data Femur_Cancer;
set work.discharges;
LCL=(Femur_Cancer-StdevF);
UCL=(Femur_Cancer+StdevF);
phat=(3914/13096513);
x1=Femur_Cancer/Total_Discharges;
u1=((x1-phat)/STERRF)*((x1-phat)/STERRF);
run;
proc print data=Femur_Cancer;
sum Femur_Cancer;
sum Total_Discharges;
sum u1;
run;
proc template;
define statgraph myBchart;
begingraph;
entrytitle 'Primary Femur Cancer Discharges (2000-2009)';
layout overlay / xaxisopts=(type=discrete) yaxisopts=(type=Linear);
barchart x=year y=Femur_Cancer/ stat=sum;
scatterplot x=year y=Femur_Cancer/ markerattrs=(size=0) yerrorlower=LCL yerrorupper=UCL; endlayout; endgraph; end;
run;
PROC SGRENDER
DATA=Femur_Cancer TEMPLATE=myBchart;
RUN;

proc template;
define statgraph myBchart;
begingraph;
entrytitle 'Percent Primary Femur Cancer Discharges to Non-Births (2000-2009)';
layout overlay / xaxisopts=(type=discrete) yaxisopts=(type=Linear);
barchart x=year y=Per_FC/ stat=sum;
scatterplot x=year y=Per_FC/ markerattrs=(size=0) yerrorlower=None yerrorupper=None; endlayout; endgraph; end;
run;
PROC SGRENDER
DATA=Femur_Cancer TEMPLATE=myBchart;
RUN;

************Gender***************;
proc import datafile='C:\Users\williams\Desktop\Gender.xlsx' out=work.Discharges dbms=xlsx replace;
run;
data Gender;
set work.discharges;
LCL=(Percent_G-StdevPG);
UCL=(Percent_G+StdevPG);
phat=(3914/13096513);
x1=Percent_G/Femur_Cancer;
u1=((x1-phat)/STERRG)*((x1-phat)/STERRG);
run;
proc print data=Gender;
sum Percent_G;
sum Femur_Cancer;
sum u1;
run;
proc template;
define statgraph myBchart;
begingraph;
entrytitle 'Percent Primary Femur Cancer Discharges by Gender (2000-2009)';
layout gridded / border=false;
   layout datalattice columnvar=Year1 / headerlabeldisplay=value cellwidthmin=50
columnheaders=bottom border=false columndatarange=union
columnaxisopts=(display=(line tickvalues))
rowaxisopts=(offsetmin=0 linearopts=(viewmax=100 tickvaluepriority=true)
PROC SGRENDER DATA=Gender TEMPLATE=myBchart;
RUN;

**************Age***************;
DATA Age;
SET work.discharges;
LCL=(Percent_Age-Stdevpage);
UCL=(Percent_Age+Stdevpage);
RUN;
PROC PRINT DATA=age;
RUN;
PROC template;
define statgraph myBchart;
BEGINGRAPH;
ENTRYTITLE ’Percent Primary Femur Cancer Discharges by Age (2000-2009)’;
layout gridded / border=false;
   layout datalattice columnvar=Year2 / headerlabeldisplay=value cellwidthmin=50
columnheaders=bottom border=false columnndatarange=union
columnmaxisopts=(display=(line tickvalues))
rowaxisopts=(offsetmin=0 linearopts=(viewmax=100 tickvaluepriority=true)
   label=’Percent Age to Primary Femur Cancer’ griddisplay=off);
  layout prototype / walldisplay=(fill);
  barchart x=age y=percent_Age / group=age name=’a’ barlabel=true skin=modern
     outlineattrs=(color=black);
  scatterplot x=age y=percent_Age / yerrorlower=none yerrorupper=none
     markerattrs=(size=0)
        errorbarattrs=(thickness=1) datatransparency=0.6;
  endlayout;
  endlayout;
  entry ’ ‘;
  discretelegend ’a’ / title=’ ’ border=true;
  endlayout;
endgraph;
RUN;
PROC SGRENDER
DATA=Age TEMPLATE=myBchart;
RUN;

*************Insurance***************;
data Insurance;
set work.discharges;
LCL=(Percent_Ins-Stdevins);
UCL=(Percent_Ins+Stdevins);
run;
proc print data=insurance;
run;
proc template;
define statgraph myBchart;
begingraph;
entrytitle 'Percent Primary Femur Cancer Discharges by Insurance (2000-2009)';
layout gridded / border=false;
  layout datalattice columnvar=Year3 / headerlabeldisplay=value cellwidthmin=50
    columnheaders=bottom border=false columndatarange=union
    columnaxisopts=(display=(line tickvalues))
    rowaxisopts=(offsetmin=0 linearopts=(viewmax=100 tickvaluepriority=true)
      label='Percent Insurance to Primary Femur Cancer' griddisplay=off);
  layout prototype / walldisplay=(fill);
    barchart x=insurance y=percent_Ins / group=Insurance name='a' barlabel=true
      skin=modern
      outlineattrs=(color=black);
    scatterplot x=Insurance y=percent_Ins / yerrorlower=none yerrorupper=none
      markerattrs=(size=0)
      errorbarattrs=(thickness=1) datatransparency=0.6;
  endlayout;
endlayout;
entry ' ';
discretelegend 'a' / title='' border=true;
endlayout;
endgraph;
end;
run;
PROC SGRENDER
DATA=Insurance TEMPLATE=myBchart;
RUN;

***********Amputation****************;
data Amputation;
set work.discharges;
LCL=(Amputation-StdevAMP);
UCL=(Amputation+StdevAMP);
run;
proc template;
define statgraph myBchart;
begingraph;
entrytitle 'Percent Primary Procedure of Amputation (2000-2009)';
layout overlay / xaxisopts=(type=discrete) yaxisopts=(type=Linear);
  barchart x=year y=Per_amp/ stat=sum;
  scatterplot x=year y=Per_amp/
PROC SGRENDER
DATA=Amputation TEMPLATE=myBchart;
RUN;

data combproc2012;
set ffracture2012;
if PR1 in ("7735") then Procedure="Removal of Articulation End of Bone";
if PR1 in ("7765") then Procedure="Local Excision";
if PR1 in ("7785") then Procedure="Partial Ostectomy Right Femur";
if PR1 in ("7787") then Procedure="Partial Ostectomy Tibia";
if PR1 in ("7795") then Procedure="Total Ostectomy Femur";
if PR1 in ("7805") then Procedure="Bone Graft Femur";
if PR1 in ("7825") then Procedure="Limb Shortening Procedures";
if PR1 in ("7835") then Procedure="Limb Lengthening Procedures";
if PR1 in ("7855") then Procedure="Internal Fixation";
if PR1 in ("7935") then Procedure="Open Reduction";
if PR1 in ("8410") then Procedure="Lower Limb Amputation";
if PR1 in ("8415") then Procedure="Amputation Below Knee";
if PR1 in ("8416") then Procedure="Disarticulation Knee";
if PR1 in ("8417") then Procedure="Disarticulation Hip";
if PR1 in ("8419") then Procedure="Abdominopelvic Amputation";
if (sex=1) then nsex="male";
if (sex=2) then nsex="female";
if (female=0) then nsex="male";
if (female=1) then nsex="female";
if (age >= 0) and (age <= 4) then grAge = "0-4";
if (age >= 5) and (age <= 9) then grAge = "5-9";
if (age >= 10) and (age <= 14) then grAge = "10-14";
if (age >= 15) and (age <= 18) then grAge = "15-18";
run;
Goptions reset=all ftext='Arial/bo' cback=white ctext=black htext=2;
Pattern value=solid color=blue;
proc gchart data=combproc2012;
hbar Procedure/ discrete type=percent nostat descending subgroup=grage;
title 'Femur Cancer Discharges with Femur/Hip Procedures in 2012';
run;
quit;

data Procedure;
set ffracture2012;
nPR1=(PR1/44);
run;
Proc surveyfreq data=procedure;
stratum kid_stratum;
cluster hosp_kid;
weight discwt;
tables nPR1;
**********Multiple Regression******************************;

data comb2000;
set combined2000;
if LOS=0 then LOS=1; else LOS=LOS;
if (totchg<1) then delete;
tot=((CCR_kid*totchg)/LOS)*1.33;
totL=(totchg/LOS)*1.33;
if PR1 in ("8410","8415","8416","8417","8418","8419") then Group =0; else group=1;
if (Pay1=1) or (Pay1=2) then nPay1=1;
if (Pay1=3) then nPay1=2;
if (Pay1=4) or (Pay1=5) then nPay1=3;
if (age >= 0) and (age <= 4) then grAge = "4";
if (age >= 5) and (age <= 9) then grAge = "2";
if (age >= 10) and (age <= 14) then grAge = "3";
if (age >= 15) and (age <= 18) then grAge = "1";
if (APRDRG_Severity=0)or (APRDRG_Severity=1) then complication=1; else complication=0;
run;

proc print data=comb2000;
var LOS;
run;

proc surveymeans data=comb2006;
weight discwt;
cluster hospid;
strata kid_stratum;
var Tot;
domain hospst;
ods output domain=comb2006;
run;

****Data sets of total charge for 2003-2009***;

proc freq data=comb2003;
table complication;
run;

proc surveyreg data=comb2000;
strata kid_stratum/nocollapse;
cluster hospid;
weight discwt;
class female npay1 group grage hosp_region;
model totL=grage female npay1 NDX group hosp_region/solution;
domain _imputation_;
ods output parameterestimates=ex3est (where=(_Imputation_ ne .));
run;

data ex3est;
set ex3est;
parameter =compress(parameter);
run;
proc mianalyze parms=ex3est;
model effects intercept grage1 grage2 grage3 grage4 female0 female1 npay11 npay12 npay13 NDX Group0 group1 hosp_region1
hosp_region2 hosp_region3 hosp_region4;
run;
***hospstAR
hospstAZ
hospstCA
hospstCO
hospstFL
hospstGA
hospstHI
hospstIA
hospstIL
hospstIN
hospstKS
hospstKY
hospstMA
hospstMI
hospstMN
hospstMD
hospstMN
hospstMO
hospstNJ
hospstNC
hospstNV
hospstNY
hospstOH
hospstOK
hospstOR
hospstRI
hospstSC
hospstSD
hospstTN
hospstTX
hospstUT
hospstVA
hospstVT
hospstWA
hospstWI
hospstWV*******;
run;
***hosp_region1
hosp_region2 hosp_region3 hosp_region4***;

***hosp_region1
hosp_region2 hosp_region3 hosp_region4****;
*******For data sets 1997-2012************;
proc import datafile='C:\Users\Tawanna\Desktop\Multreg2000.xlsx' out=work.multreg2000
dbms=xlsx replace;
run;
**********Complications**********;

proc surveylogistic data=comb2003;
   strata kid_stratum;
   cluster hospid;
   weight discwt;
   class female npay1 grage hospst/param=ref;
   model complications (event='1') = female grage npay1 NDX hosp_ree group;
   domain _imputation_
   ods output parameterestimates=ex3est (where=(_Imputation_ ne .));
   run;

proc mianalyze parms(classvar=classval)=ex3est;
   class female grage hospst;
   modeleffects intercept female grage NDX;
   run;

R Code

Classification Trees

TRC$group<-factor(TRC$group)
TRC$FEMALE<-factor(TRC$FEMALE)
TRC$Comp<-factor(TRC$Comp)
TRC$SEX<-factor(TRC$SEX)
sapply(TRC,class)

TRC<-rpart(group~AGE+HOSP_REGION+nPay1+FEMALE+NDX+Comp,data=TRC)
rpart.plot(TRC)
rpart.plot(TRC, main= "Classification of Amputations in Femur Cancer Discharges in 2012", extra=1, type=4)

TRC<-rpart(group~AGE+H_REGION+nPay1+SEX+NDX+RACE,data=TRC)
rpart.plot(TRC)
rpart.plot(TRC, main= "Classification of Amputations in Femur Cancer Discharges in 1997", extra=1, type=4)

Basket Analysis

library(arules)
library(arulesViz)
sapply(TRC1,class)
TRC<-read.csv("DX1997.csv", header=TRUE, sep="", stringsAsFactors=FALSE)
TRC$DX1<-as.factor(as.character(TRC$DX1))
TRC$DX2<-as.factor(as.character(TRC$DX2))
TRC$DX3<-as.factor(as.character(TRC$DX3))
TRC$DX4<-as.factor(as.character(TRC$DX4))
TRC$DX5<-as.factor(as.character(TRC$DX5))
TRC$DX6<-as.factor(as.character(TRC$DX6))
TRC$DX7<-as.factor(as.character(TRC$DX7))
TRC$DX8<-as.factor(as.character(TRC$DX8))
TRC$DX9<-as.factor(as.character(TRC$DX9))
TRC$DX10<-as.factor(as.character(TRC$DX10))
TRC$DX11<-as.factor(as.character(TRC$DX11))
TRC$DX12<-as.factor(as.character(TRC$DX12))
TRC$DX13<-as.factor(as.character(TRC$DX13))
TRC$DX14<-as.factor(as.character(TRC$DX14))
TRC$DX15<-as.factor(as.character(TRC$DX15))
TRC$DX16<-as.factor(as.character(TRC$DX16))
TRC$DX17<-as.factor(as.character(TRC$DX17))
TRC$DX18<-as.factor(as.character(TRC$DX18))
TRC$DX19<-as.factor(as.character(TRC$DX19))
TRC$DX20<-as.factor(as.character(TRC$DX20))
TRC$DX21<-as.factor(as.character(TRC$DX21))
TRC$DX22<-as.factor(as.character(TRC$DX22))
TRC$DX23<-as.factor(as.character(TRC$DX23))
TRC$DX24<-as.factor(as.character(TRC$DX24))
TRC$DX25<-as.factor(as.character(TRC$DX25))
(trans<-as(TRC, "transactions"))
basket_rules<-apriori(trans,parameter=list(sup=0.5, conf=0.9, target="rules"))
itemFrequencyPlot(trans,topN=20,type="absolute")
rules<-apriori(trans, parameter=list(supp=0.001, conf=0.8))
options(digits=2)
inspect(rules[1:20])
rules<-sort(rules,by="confidence", decreasing=TRUE)
subset.matrix<-is.subset(rules, rules)
subset.matrix[lower.tri(subset.matrix, diag=T)]<-NA
redundant<-colSums(subset.matrix, na.rm=T)>1
rules.pruned<-rules[!redundant]
rules<-rules.pruned

str(TRC)
rules<-apriori(TRC, parameter=list(minlen=2,supp=0.00005,conf=0.80),
appearance=list(rhs=c("PR1=Amputation"),default="lhs"))
rules<-sort(rules, decreasing=TRUE, by="support")
inspect(rules[1:10])
(trans<-as(TRC, "transactions"))
basket_rules<-apriori(trans,parameter=list(sup=0.001, conf=0.9, target="rules"))
itemFrequencyPlot(trans,topN=20,type="absolute")

plot(rules)
plot(rules, method="grouped")

Incidence Rates

TRC1<-read.csv("MAPS.csv", header=TRUE, sep="", stringsAsFactors=FALSE)
TRC1<-read.delim("clipboard")

library(maps)
library(ggplot2)
us<-map_data("state")
d<-data.frame(us)
head(d)
TRC1$region<-TRC1$State
TRCm <- merge(us,TRC1, by="region")
TRCm <- merge(us,TRC1, all=TRUE)
head(TRCm)
TRCm <- TRCm[TRCm$region!="district of columbia",]
TRCm <- TRCm[order(TRCm$order),]

p <- ggplot()
p <- p + geom_polygon(data=TRCm, aes(x=long, y=lat, group = group,
fill=TRCm$totchg),colour="white"
   ) + scale_fill_continuous(low = "gray95", high = "darkred", guide="colorbar")
P1 <- p + theme_bw() + labs(fill = "Femur Cancer Total Charges 2006"
   ,title = "Incidence of Femur Cancer in 2003", x="", y="")
P1 + scale_y_continuous(breaks=c()) + scale_x_continuous(breaks=c()) + theme(panel.border = element_blank())
p <- ggplot()
p <- p + geom_polygon(data=TRCm, aes(x=long, y=lat, group = group, fill=TRCm$totchg),colour="white") + scale_fill_gradient2(low="gray95",high="darkred",mid="thistle1",midpoint=16, limit=c(0.1,75))
P1 <- p + theme_bw() + labs(fill = "Femur Cancer Incidence Rate \n per 1,000,000 less than 18 Years"
               ,title = "Incidence of Femur Cancer in 2000", x="", y="")
P1 + scale_y_continuous(breaks=c()) + scale_x_continuous(breaks=c()) + theme(panel.border = element_blank())