Analysis of Post-Neo-Natal Inpatient Hospitalizations in the United States

By

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Abstract

According to the Organization for Economic Cooperation and Development (OECD), the United States expenditure on health care exceeds all other developed countries with similar income and lifestyle. Gross Domestic Product (GDP) expenditure in the U.S. on health was 17.5% in 2016 or $10000 per capita compared to 10% GDP or $2781 in the EU. Yet, Europeans have longer life spans of 83 years in the EU versus 78 in the USA. Infant mortality is at 2.3 per 1000 live births in Scandinavian countries compared to 5.6 in the USA. Infant hospitalization and inpatient care affect a large proportion of the population and significantly impact the economy. There are vast differences geographically and financially throughout the country in patient health outcomes, treatment preferences, availability and access to health care services. Healthcare equity remains a national political debate with 15% or 27.4 million non-elderly Americans still uninsured in 2017 compared to other developed countries which have almost 100% universal coverage. People at increased risk of poor health are also likely to perform specific health behaviors e.g. those without health insurance, those with fewer resources, those with less education, and low health literacy, or many who are already ill. Consequently, this further contributes to increased disparities in health outcomes. According to the Kaiser Family Foundation analysis of the National Health Interview Survey of 2017, 50% uninsured, 12 % publicly insured, and 11% privately insured had no usual source of care. Respondents said their usual source of care is the emergency room.

The goal of this study is to evaluate post-neo-natal healthcare, with a focus on secondary care and social determinants as some of the factors involved in healthcare inequities for socioeconomically disadvantaged families. The objective is to investigate hospitalization for infants and some of the demographics affecting inpatients in order to identify high risk populations and improve medical outcomes in post-neo-natal health. The hypothesis is to

determine whether primary diagnoses, length of stay, hospital outcomes or patient disposition, and total charges of post-neo-natal admissions differ with race, income bracket, insurance type, or geographic regions in the United States.

A Cross-Sectional Study was conducted with a population of 871845 inpatients for the years 2012-2014 with infants 28-364 days old using Hospital Cost and Utilization Project National Inpatient Sample (HCUP-NIS) data from the National Institute of Health (NIH) with length of stay and total charges as dependent variables and various components used as independent variables.

These results show that infants 28-364 days old in 2012, 2013, 2014 showed utilization of hospitals for care that may be classified as routine 92.7% of the time. 75% were with low risk of dying, 45% with minor loss of function, over 96% were not under major substances of abuse, 58% did not require any procedures, 53% did not have chronic morbidities, and 45% were not even eligible for emergency room billing. The total charges accrued were paid for by Medicaid as primary payer 64% of the time, and private insurance 30% of the time. Over a third (37%) of inpatients came from the lowest household median income in the country (0- 25000 zip quartile income percentile) and a quarter (25%) were of the next level (25-60000 zip quartile income). Regional dynamics accounted for variations in mean total charges of $27,704.45 in the East South Central region to $61,911.58 in the Pacific per length of stay (LOS). The mean LOS was 4.72 days and sum total charges nationally were $34,727,880,784. The covariance showed that 85% length of stay an 82% of total charges are explained by the various independent variables collectively in the regressions and they are comprised of social determinants of health, hospital based activities, and patient centered components.

Consequently, the recommendation is to link infant postnatal care with maternal postpartum care synergistically and continuously identify the root cause of hospitalization. Patients need to be identified- stratified-triaged upon admission and redirected back to primary care if appropriate

to reduce unnecessary hospitalizations and emergency visits. We need to optimize transition of care post discharge to avoid readmissions, encourage routine scheduled well-visits in ambulatory care settings, improve ongoing patient engagement and education to empower them to take more responsibility for their own health and diffuse care to preventive primary care settings, and improve compliance with healthcare protocols for postnatal infants and postpartum mothers by linking data for infants and mothers and including SDoH for value based care.

CHAPTER I

INTRODUCTION

1.1 Goals & Objectives:

The goal of this study is to evaluate post-neo-natal healthcare, with a focus on secondary care and social determinants as some of the factors involved in healthcare inequities for socioeconomically disadvantaged families.

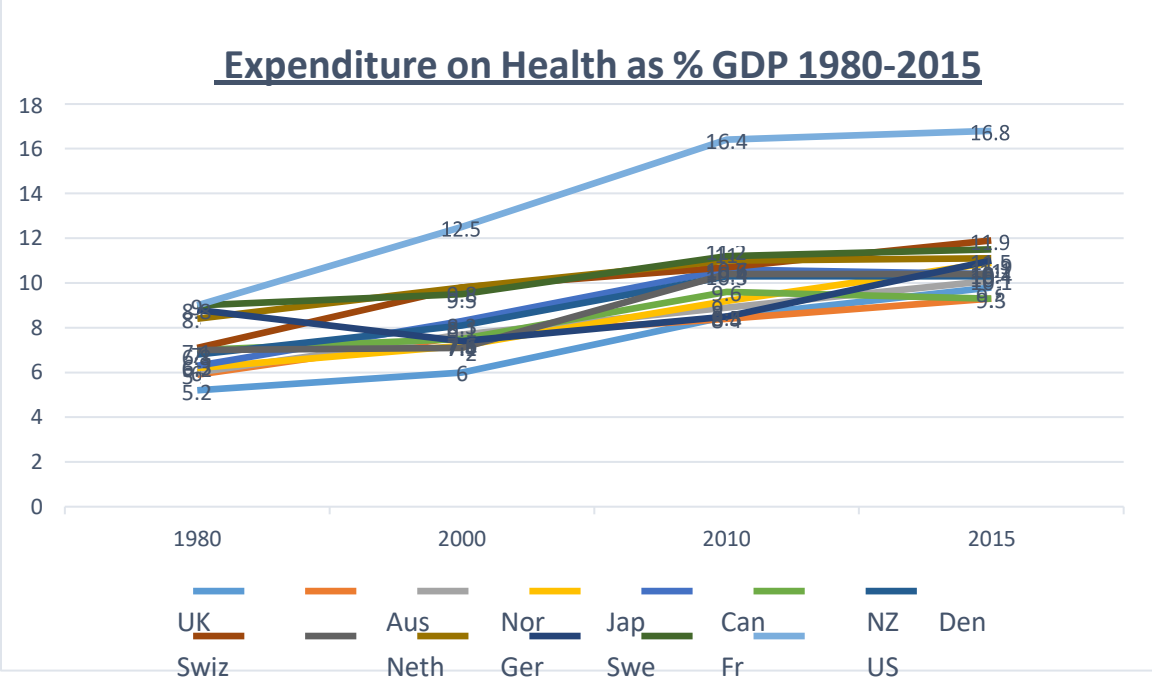
The objective is to investigate hospitalization for infants and some of the demographics affecting inpatients in order to identify high risk populations and improve medical outcomes in post-neo-natal health.

Quality for healthcare in prenatal and postnatal children (neo-natal or 1-27 days old and post- neo-natal or 28-364 days old) is greatly impacted by various factors, such as integrated patient centered care, digitally compatible health informatics tools, workforce support, and financing. These aspects need to be further investigated for greater insight and evidence based assessments.

1.2 Statement of Problem and Background

1.2.a Statement of Problem

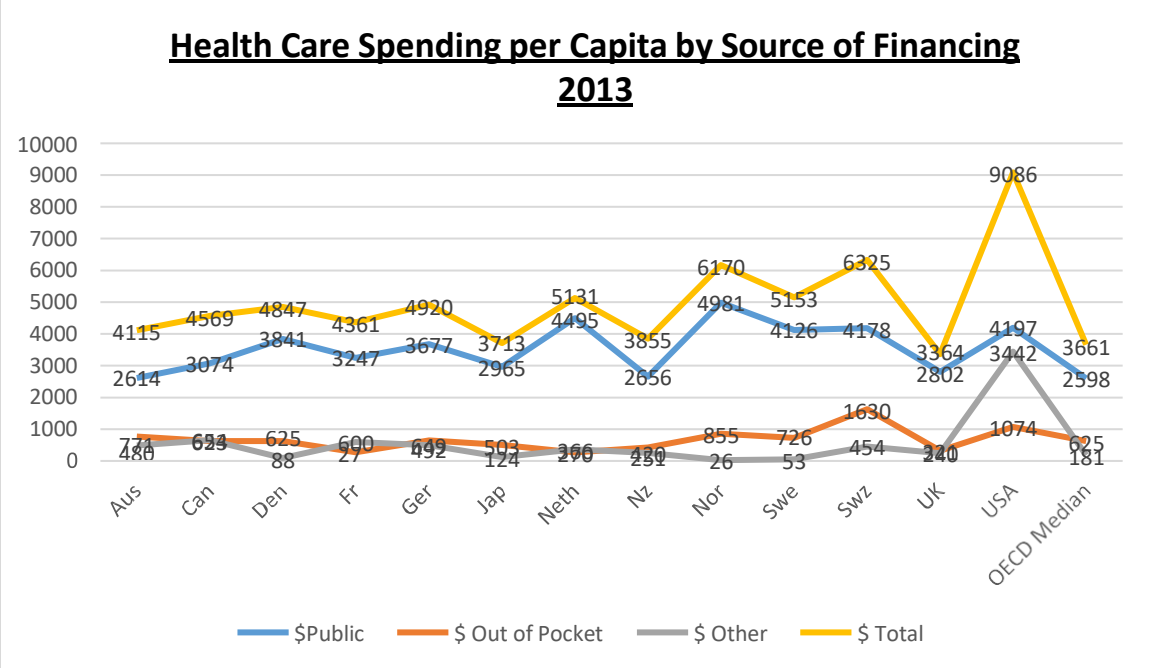
According to data from the Organization for Economic Cooperation and Development (OECD), the United States expenditure on health care exceeds all other nations by far when compared to various high income countries with similar lifestyles. Especially, in terms of supplies and utilization of health services and resources , yet this extra added investment is not reflected in our health outcomes.



Percent Gross Domestic Product Health Care Spending from OECD Health Data 2017

Chart 1. Health Expenditure GDP

The Center for Medicare and Medicaid Services (CMS) predicts GDP will rise from 17.5% in 2016 to 20.1% in 2025. According to the Common Wealth Fund, the USA cost per head for healthcare in 2013 was $9086 and is expected to rise to $10000 per capita by 2025. Health spending in the U.S. is the highest in the world followed by Switzerland at $6325.[8] In the European Union health expenditure is at 10% GDP ($2781), yet Europeans have longer life spans (83 EU vs 78 USA) and other better outcomes of health.

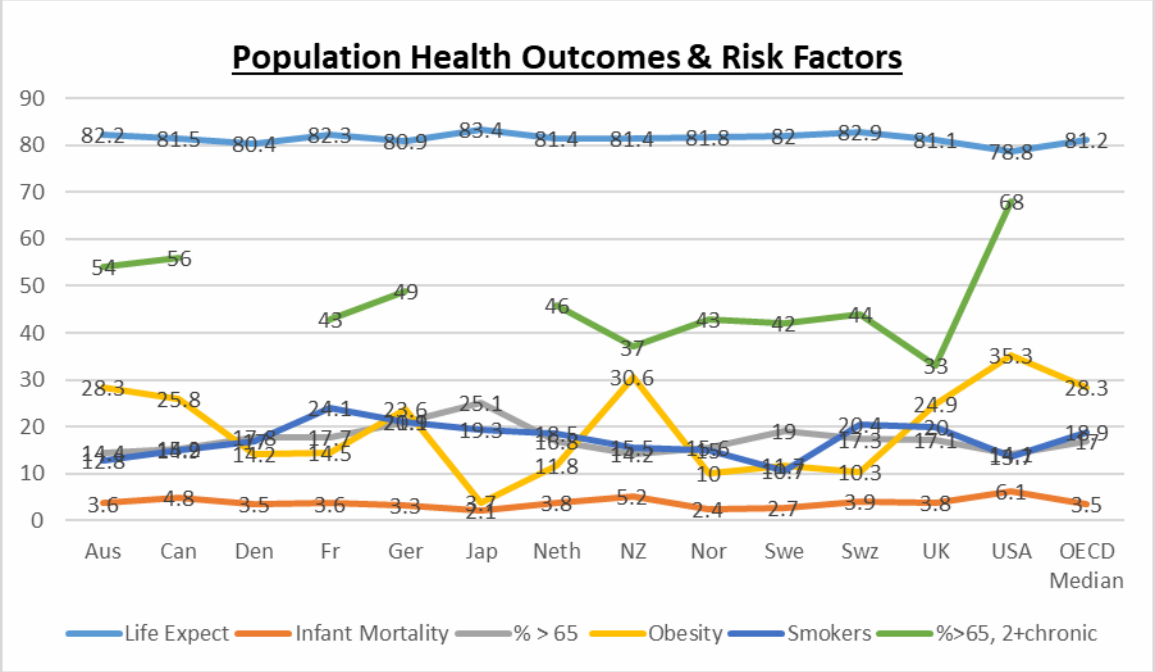


OECD Health Data 2015, Numbers may not sum to total health care spending per capita due to excluding capital formation of health care providers and some uncategorized spending.

Chart 2. Health Care Spending per Capita

1.2.b Background

Health outcomes are not all optimal in the US, including higher prevalence of chronic conditions and shorter life expectancy. The median life expectancy is 81.2 years at birth for developed countries in 2013 yet the USA is at 78.8 years. Co-morbidities at elderly populations are higher in the USA than any other country. 68% of adults 65 years or older have 2 or more chronic conditions like hypertension, high blood pressure, heart disease, diabetes, lung problems, mental health problems, cancer, joint pain/arthritis. Infant mortality is also highest in the U.S. at 6.1 per 1000 live births, ranking 55 out of 225 nations in 2017 according to the Central Intelligence Agency.65 The U.S. has one of the lowest smoking rates. Yet it is leading in obesity rate BMI>3 at 35.3% which is 5.3% higher than the next leading nation New Zealand.



OECD Health Data 2013, reported 2015

Chart 3. Population Health Outcomes & Risk Factors

The Affordable Care Act and Alternate Payment Programs have introduced multiple concepts to reform healthcare, improve outcomes, and reduce cost. Some of the most significant inclusions are greater healthcare coverage, increased access to healthcare, social determinants as basic components of health, and value based services. The new payment models influence decision making and risk sharing and spread the cost of health services across a larger pool of stakeholders in our healthcare system. This highlights the need to investigate patient populations more vulnerable to social aspects and more prone to need and utilize health services. It also calls for the review of services and utilization in primary and secondary care approaches, in order to allow increased lateral uptake of healthcare services efficiently, direct spending appropriately, and improve health outcomes. There are vast differences geographically and financially throughout the country in patient health outcomes, treatment preferences, availability and access to health care services and a host of other dynamics.

In order to optimize health system performance, there needs to be optimal interaction and shared responsibility between the four pillars of a health system in terms of health governance, health payers, health providers, and health recipients or patients. Ideally, a good place to start is from the beginning of healthcare for vulnerable patient populations to assess and instill adequate protocols by governance bodies, habits or best practices for patients and providers, processes by the services conducted, finances by funding bodies, and to reset and align the goals and expectations for all stakeholders involved. In practice, in a human life span and health journey, optimal healthcare starts just before birth at prenatal care, and the first hospitalization is at birth. Liveborn (newborn infant) is the most common reason for hospitalization in the U.S., accounting for more than 3.9 million stays in 2010 (10 percent of all stays). The highest hospitalization rate by age group in the country is for infants less than one year old.[78] “Among hospitalized adults

ages 18–44, 4 of the top 5 conditions are related to pregnancy and childbirth: trauma to the perineum and vulva due to childbirth, maternal stay with a previous Cesarean section, prolonged pregnancy, and hypertension complicating pregnancy and childbirth."[78] Infant hospitalization and inpatient care affect a large proportion of the population and significantly impact the economy. The best time to start healthy habits is from infancy, and maternity care is pivotal to avoid missed prevention opportunities including health behavioral changes for maternal and infant care to proactively initiate optimal continuum of care from birth to end of life.

CHAPTER II

LITERATURE REVIEW

2.1 Background and Significance

In a systematic review of 626 references for clinical guidelines of postpartum women and infants in primary care, the scope of the guidelines varied greatly, and the level and grade of evidence varied between guidelines.[53] Only one guideline provided comprehensive recommendations for the care of postpartum women and their infants.[53] The quality of most guidelines was adequate, and the suggested time of routine visits was mainly 4 to 6 weeks post birth. The timing and contents of routine care were inconsistent for mother and infant when compared between and within countries. These findings can help explain current practices in post-neo-natal care and shed light into future direction.

Postpartum care in the community can prevent short, medium, and long term consequences of unrecognized and poorly managed problems plus standardized instructions can set the stage to ensure consistency of care throughout the post-natal phase of life.[53]

Fig 1 Current Maternal and Infant Post-Natal Guidelines from Around the World

		Beyond Blue-Perinatal Depression	Faculty of Sexual & Reproductive Health (FSRH)	Institute for Clinical System Improvement (ICSI)	National Institute for Health & Clinical Excellence (NICE)	Royal Australian College of General Practitioners (RACGP)	Scottish Intercollegiate Guidelines Network (SIGN)	Japan Society of Obs & Gyn And Japan Association of Obs & Gyn	World Health Organization (WHO)
Country, year		Australia, 2011	UK, 2009	USA, 2012	UK, 2006	Australia, 2012	UK, 2012	Japan, 2011	Global, 2010
Organization		Non profit, gov sponsorship	Professional Body	Gov Org	Gov Org	Professional Body	Gov Org	JSOG, JAOG	WHO
Maternal Health	Physical wellbeing				Y	Y		Y	Y
	Contraception		Y		Y			Y	Y
Maternal Mental Health	Emotional wellbeing	Y			Y	Y	Y	Y	Y
	Screening tools	Y			Y	Y	Y	Y	Y
	Postnatal depression Treatment	Y					Y	Y	Y
Infant Health	Physical wellbeing			Y	Y	Y		Y	Y
	Parent-infant relationship	Y		Y				Y	Y
Breastfeeding	Breastfeeding			Y	Y	Y		Y	Y
	Medication while breastfeeding	y	y				y	Y	Y
Timing of visits		6-12w implied, no clin care pthwy	Implied, no clin care pthwy	2w, 2-4-6-9-12-15m	24h, 2-7d, 2-8w	6-8w implied, no clin care pthwy	4-6w, 3-4m implied, no clin care pthwy	5d, 5-6w	At least 6 weeks

2.2 Significance of the Problem

The diagram below is a timeline to highlight the multiple events taking place simultaneously during the first 12-15 months of infant life and post discharge after birth experience. It is a critical transition from secondary to primary care and new mothers can be overwhelmed with their own health and that of their newborn. Maternal reproductive healing, breast feeding, immunizations, changes in sleeping patterns for both mother and infant, reproductive health, major lifestyle changes, and balancing life-work-home can collectively and understandably take a toll on mental health.

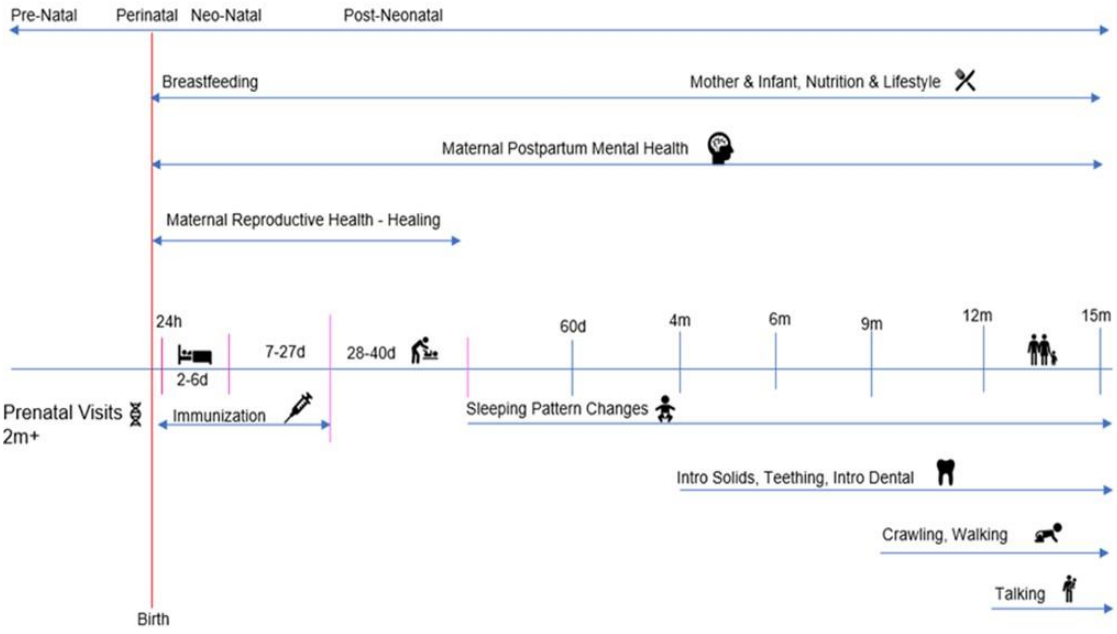


Fig 2. Post-Partum Timeline with Critical Events in the first 12 months Infant Life

Neo-Natal care scores better in the US than in most developed nations and in general by common clinical and social practice infants 0-27 days old receive special attention whether at high risk or not. The Vaccine schedule for neo-natal infants also draws great focus to this age group. Both Clinical and social interest in newborns starts to decrease after 6-8 weeks. Infants of Post-

Neo-Natal age also fall through the cracks if their condition falls in importance between a medical necessity for home healthcare and routine physician visits. Hence there is a shortfall in routine screening to optimize infant health in a comprehensive, cost effective, infant centered manner to reduce risk, prevent additional health problems, reduce stressors and ameliorate the well-being of this age group. There is a need to assess post-neo-natal care, demographics, socioeconomic variances and how closely post-neo-nates are followed post discharge.

Value or merit based care that has been recently deployed is strategic remedy for health reform alongside the emerging political spotlight on the health care agenda. It requires a research to establish its effect and continue to feed data for ongoing assessments on the validity of these new initiatives. To that effect, health indicators such as coverage, access, demographics and socioeconomic development have demonstrated to be a significant component of our health score as we navigate the inclusion of social determinants and their impact on individual behavior in order to reconfigure our goals in healthcare delivery.

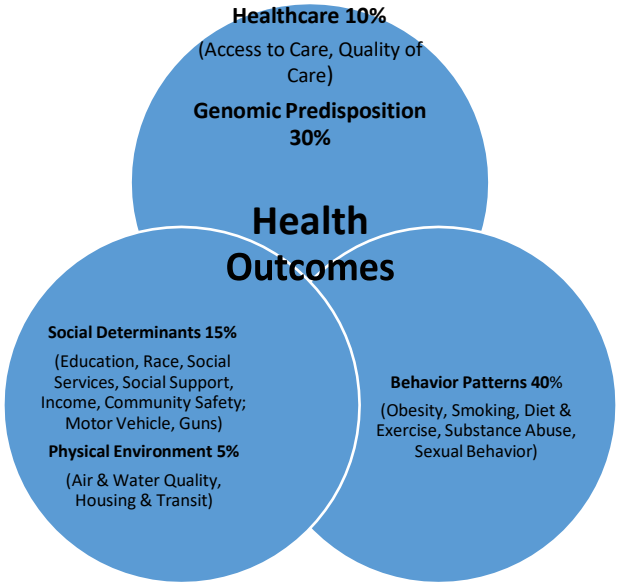


Fig 3. Demographics and Socio-Economic Statistics for Personalized Care Management

According to the World Economic Forum & NASEM Report,[62,63] social risk factors and the environment also have a significant part to play in the well-being of patients. Social determinants account for 20% of health outcomes, healthcare 10%, genomics 30%, and individual behavior 40%.[35,48] Alternatively, the 2018 County Health Rankings and Roadmap findings reported 30% health behaviors, 20% clinical care, 10% physical environment, and 40% socio-economic factors.

Socioeconomic data has shown that people at increased risk of poor health are also likely to perform specific health behaviors; those without health insurance, those with fewer resources, those with less education, & low health literacy, older people, many who are already ill and consequently, contributing further to increased disparities in health outcomes.[64]

Social behavioral profile via predictive healthcare models like companion diagnostic algorithm can drive efficacy of care programs. Meanwhile, value based payments aim to reduce disparities in care access, and quality by considering social risk factors.

Part of healthcare effectiveness is in access or availability and utilization of available resources such as hospitalization. Hospital inpatient care cost is almost a third of all healthcare expenditure in the United States representing a significant impact on the economy. Great healthcare indicates a growing and aging population which may in turn represent higher prevalence of chronic conditions and consequently higher hospitalization rates. There are also substantial variations in diverse and dynamic populations across the vast geographies. These differences may emerge as a result of differences in patient health status, treatment preferences, provider patterns of practice, access and availability of services, societal and cultural dynamics, and socioeconomic differences such as income and insurance coverage.

2.3 Transition from Fee-for Service to Value Based Care

In the fee-for-service approach, hospitals were compensated based on metrics related to productivity to optimize revenue rather than patient outcomes or community benefit. Reconfiguring from traditional fee for service payments to health outcomes and patient centered care was recommended by the meaningful use initiative to offer a more promising approach in improving the quality of health care, cost effectiveness and service efficiency with better utilization of patients as health consumers as well as a health resource.

Timing, integration, and interoperability are all metrics directly related with merit based, quality and alternative payment programs. These new payment models aim to enhance care coordination and patient engagement in care management, in order to optimize provision of care and focus on medical outcomes, patient needs, and the needs of providers to produce more viable operational changes. They incentivize public adoption of ongoing programs in large scales nationally and encourage value and care coordination rather than volume and care duplication, i.e. health waste management. This helps align financial incentives of all stakeholders in the system like payers, patients, suppliers including technology vendors, with improved medical outcomes on a risk shared basis.

2.3.a Equity and the Affordable Care Act

Equity in the American health system continues to present a major drawback even after the most recent health legislature. Instead of the common universal coverage in most developed nations with socialized medicine, health in the U.S. is not completely publicly funded and remains a major political debate in 2017 with 27.4 million Americans uninsured even after mandatory coverage of the Affordable Care Act. According to the WHO "Equity is the absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically."

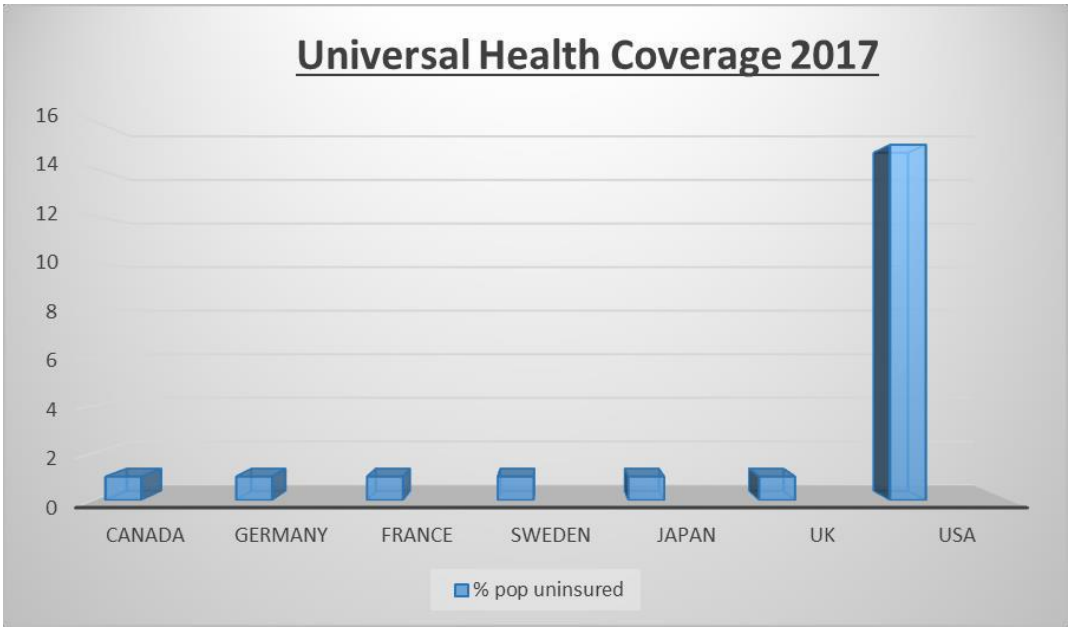


Chart 4. Universal Coverage

27.4 million (15%) non- elderly Americans were still uninsured in 2017 compared to other developed countries which have almost 100% universal coverage.

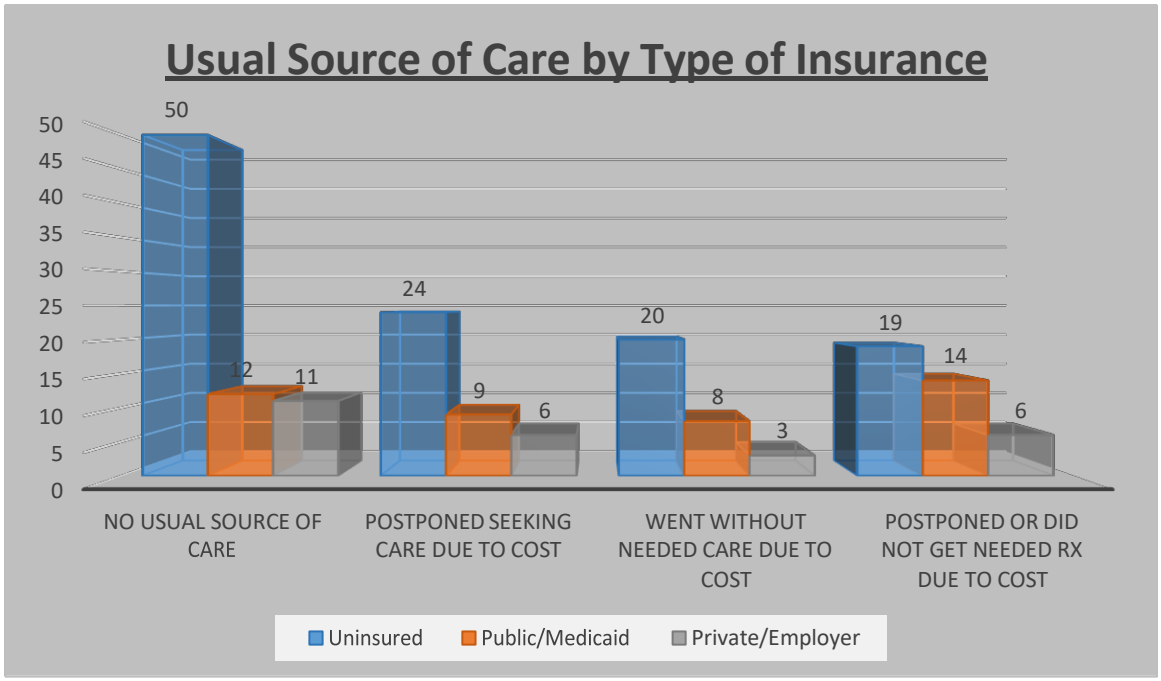


Chart 5. Barriers to Health Care by Insurance Type

According to the Kaiser Family Foundation analysis of the National Health Interview Survey of 2017, for non-elderly Americans 18-64 years old; 50% uninsured, 12 % publicly insured, and 11% privately insured had no usual source of care. Respondents who said usual source of care was the emergency room were included among those not having a usual source of care.

This lack of access to healthcare is a major challenge for disadvantaged families, especially manifested by higher IMR in ethnic minorities, with lower health insurance coverage, language barriers, lower level of education, and limited awareness of available resources. There are several variations in lifestyles, environment, and rates of violence and accidents to add to a challenging health profile. According to the Institute of Medicine, the U.S. exhibits more poor health than its counterparts for the disadvantaged economically, socially, racially and ethnically as well as the well-off, non-smoking, non-obese Americans.

There are also more confounding factors such as diabetes, ischemic heart disease etc. but it is beyond the scope of this investigation.

2.4 Geographic Discrepancies in Healthcare

There are vast differences for health outcomes throughout the United States. The Northeast and West have much lower rates compared to the South and Midwest in general. The CDC has very rich data on domestic demographics but not all states report the same contents and therefore it is challenging to produce a direct and comprehensive comparison.

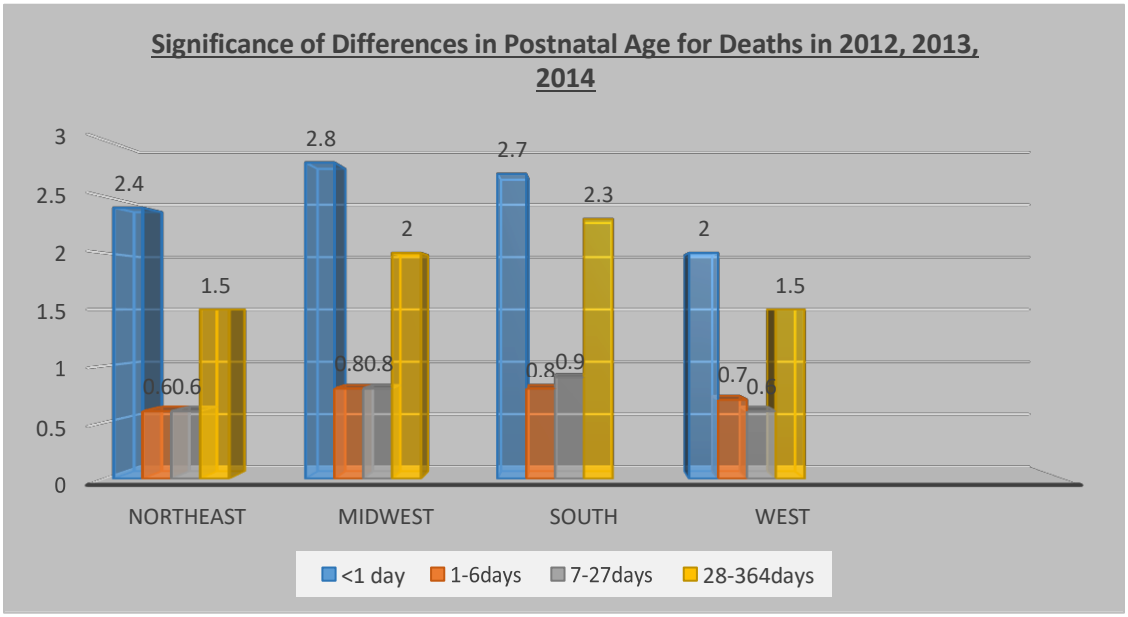
There are significant differences regarding geography including degree of urbanization. There are other factors directly impacting postnatal care such as household income, maternal educational level, maternal age, gestational period, infant age group, weight, gender, race, cause of death etc.

It is beyond the scope of this project to tackle all these factors, and some of these factors have

already been established in the literature as demonstrating direct impact.

2.4.a Significance of Geographic Regions on Post-neo-natal Health

Neonatal and post-neo-natal death rates are higher in rural counties than in large urban counties in 2014. Neonatal death was Higher in both rural and small and medium urban counties compared with large urban Counties. Post-neo-natal death decreased as urbanization level increased and was 17% higher in rural counties than in small and medium urban counties, and 49% higher than in large than Counties. Preterm, low birth weight, male, black infants in low income households are at higher risk of mortality. Maternal age & educational level are not reported in all states.



https://wonder.cdc.gov/controller/datarequest/D140;jsessionid=22A3CAEC1D1686C4E04E61E07673A069

Chart 6. Deaths by Postnatal (1-364 days) Age Groups Across Geographic Regions in the USA for 2012, 2013, 2014

Regional disparities are evident, and death is very high during the first 24 hours of life, from 2.0 in the West to 2.8 in the Midwest. Death at 1-6 days is lowest in the Northwest at 0.6 and high in the Midwest and South at 0.8, while 7-27 days is similar and lowest at 0.6 in the Northeast and West and higher at 0.7 and 0.9 in the Midwest and South respectively. These figures are expected at the Neonatal age group; however, the Post-neo-natal age group of 28-364 days exhibits death rate of 1.5 in the Northeast and West but is higher for the 2.0 at the Midwest and 2.3 in the South. Thus, the total postnatal for the regions is 4.9 for the West, 5.1 for the Northeast, 6.4 the Midwest, and 6.7 for the South making the national average 5.9

Hence it is very clear to see that the post-neo-natal age group contributes quite substantially to the total national infant death rate and this pattern continues throughout the years from 1999 to present. Infant mortality rate (IMR) in the US is higher in all ages but this difference accelerates after the first month of life. This excess post neonatal mortality does not appear to be driven by the US delaying neonatal by exceeding expectations for 24 weeks old. The post-neonatal disadvantage appears strongly even among normal birthweight infants and those with high scores APGAR.[56] APGAR stands for "Appearance, Pulse, Grimace, Activity, and Respiration." a test taken 1-5 minutes within birth to check a baby's health. It checks for breathing effort, heart rate, muscle tone, reflexes, and skin color. The Apgar score is based on a total score of 1 to 10. The higher the score, the better the baby is doing after birth such that 7, 8, or 9 score is normal good health.

Substantial morbidity occurs in the early postpartum period, more than half of pregnancy related maternal deaths occur after the birth of the infant, more than half of postpartum strokes occur within 10 days of discharge, and Maternal Mortality Rate (MMR) is much higher in the USA is 9.9 versus other developed countries like 1.3 in Iceland.[52, 53]

Studies have shown an intense focus on Women's Health prenatally but care during the

postpartum period is infrequent and late. Women are often uncertain about whom to contact for postpartum concerns. 1 in 4 postpartum women did not have a phone number for a health care provider to contact for any concerns about themselves or their infants, transition is crucial yet postpartum as the aftermath is lost & masked/confounded by the importance of birth.

More than half of women attending postpartum visits reported they did not receive enough information at the visit about postpartum depression, birth spacing, healthy eating, the importance of exercise, or changes in their sexual response and emotions. 40% of women do not attend postpartum visits, and attendance rates are lower among populations with limited resources, which further contributes to health disparities in post- neo-natal care for infants as much as mothers.

CHAPTER III

METHODOLOGY

3.1 Presumptive Statement

Social determinants of health are significantly important in the post-neo-natal care process and hence they must be incorporated into healthcare analytics.

3.2. Underlying Assumptions:

3.2.a.i Predisposing Factors:

Health System Infrastructure; Federal databases are comprehensive and seek to integrate healthcare informatics into national interoperable platforms. However, state reporting differs extensively and sometimes produces incomparable variables for research purposes.

Predisposition; race/ethnicity, age/teenage pregnancies

3.2.a. ii. Enabling Factors:

Social Determinants; parental education, income level, insurance coverage, social services, social support, language barriers, environmental factors

Individual Behavior; obesity, smoking, substance abuse, sexual behavior, motor vehicle, guns or violence

3.3 Hypothesis:

Hypothesis 1: *Primary Diagnosis* of post-neo-natal admission does not differ with race, income group, insurance type, or geographic region in the United States

Hypothesis 2: *Total Charges* of post-neo-natal admission does not differ with race, income group, insurance type, or geographic region in the United States

Hypothesis 3: *Hospital Outcomes or Disposition* of post-neo-natal patients does not differ with race, income group, insurance type, or geographic region in the United States

Hypothesis 4: *Length of Stay* of post-neo-natal admission does not differ with race, income group, insurance type, or geographic region in the United States

3.4 Cross-Sectional Study

Population of 871845 inpatients 2012-2014 infants 28-364 days old using HCUP data

3.4.a Dependent Variable: continuous numeric variables to be analyzed;

Total Charges, Length of Stay, Died

3.4.b Independent Variables: categorical variables that will be used to subset the dependent variable; Age, race, insurance status, income level, hospital region, hospital location, hospital bed size, hospital control/ownership, discharge position, emergency room admission, died, risk of mortality, severity of illness, day of admission, month of admission, number of procedures, number of diagnosis, number of chronic conditions, hospital birth, transition in of non-new-born admission source or point of origin, discharge status or transferred out to a different acute care hospital or to another type of health facility, external cause of injury, discharges with neonatal and/or maternal diagnoses and procedures

Chi-square test to evaluate categorical variables, and t-test for continuous variables, to determine if observations are due to chance, bias, or confounders. Multivariable logistic regression for covariates.

3.5 Source of Data

The source of data used in the study is the National Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP)

The NIS is the largest publicly available all-payer inpatient health care database in the United States, yielding national estimates of hospital inpatient stays. Unweighted, it contains data from more than 7 million hospital stays each year. Weighted, it estimates more than 35 million hospitalizations nationally. Developed through a Federal-State- Industry partnership sponsored by the Agency for Healthcare Research and Quality (AHRQ), HCUP data inform decision making at the national, State, and community levels.

For this research, most recent data from the 2012-2014 will be employed to conduct the required statistical tests using SPSS SOFTWARE on almost one million inpatient samples with 95% confidence interval to answer the addressed research questions stated at the body of this research proposal.

3.6 Data Variables Used in the Study

3.6.a Hospital Activity/Patient Centered Outcomes

1. HCUP_ED, emergency room visits
2. DISPUNIFORM, patient discharge
3. LOS, length of stay
4. YEAR, discharge calendar year
5. TOTCHG, Total charges

6. AWEEKEND, admitted in weekend
7. ADAY, weekday admission
8. DQTR, discharge quarter
9. NECODE, external injury
10. NEOMAT, neonate diagnosis and maternal diagnosis or procedure
11. CENSUS_DIVISION, US population census geographic hospital region
12. HOSP_LOCTEACH, Rural, Urban teaching, Urban non-teaching
13. HOSP_CONTRL, Hospital Control, ownership
14. HOSP_BEDSIZE
15. TRAN_IN, Transition In
16. TRAN_OUT, Transition Out

3.6.b Medical Factors/Service Outcomes

1. APR_DRG, Risk of mortality
2. APR_DRG, Severity of illness
3. CM_DRUG, drug comorbidity
4. CM_ALCOHOL, alcohol comorbidity
5. CM_DM, Diabetes Mellitus
6. CM_HTN_C Hypertension comorbidity
7. NCHRONIC, number of chronic conditions
8. NCHRONB1, body system with chronic condition
9. CM_PULM, Pulmonary condition
10. CM_CHF, Congestive Heart Failure

11. NDX, number of diagnosis on record
12. NPR, number of procedures on record
13. Dx1, primary diagnosis
14. DIED

3.6.c Demographics/Social Determinants

1. PAY1, primary payer or health insurance type
2. ZIPINC_QRTL, household median income
3. RACE, ethnicity
4. FEMALE, gender
5. PL_NCHS, metropolitan, micropolitan, county size

CHAPTER IV

RESULTS

4.1 Descriptive Analytics, Frequencies, Means, Cross Tabulations, Regressions

The following results were obtained from an initial descriptive analysis of the variables mentioned above for the 871845 selected cases of 2012, 2013, 2014 infants of ages 28-364 days.

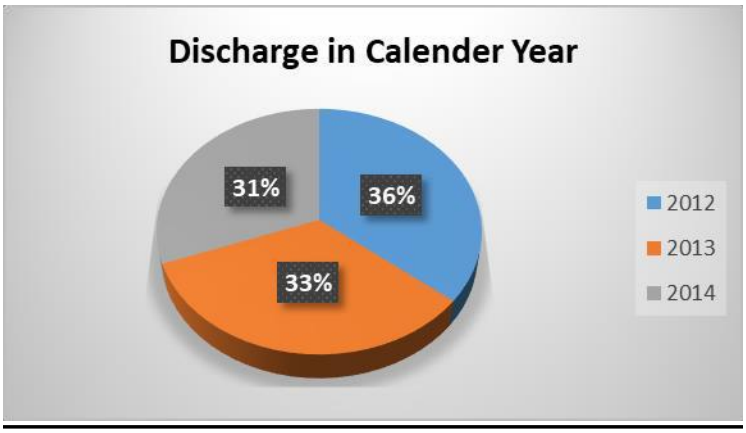


Chart 7. Discharge Year

In 2012 36% were discharged versus 33% in 2013 & 31% in 2014. Reduced hospital visits

4.2 Infant Population and Hospitalization for United States Census Divisions

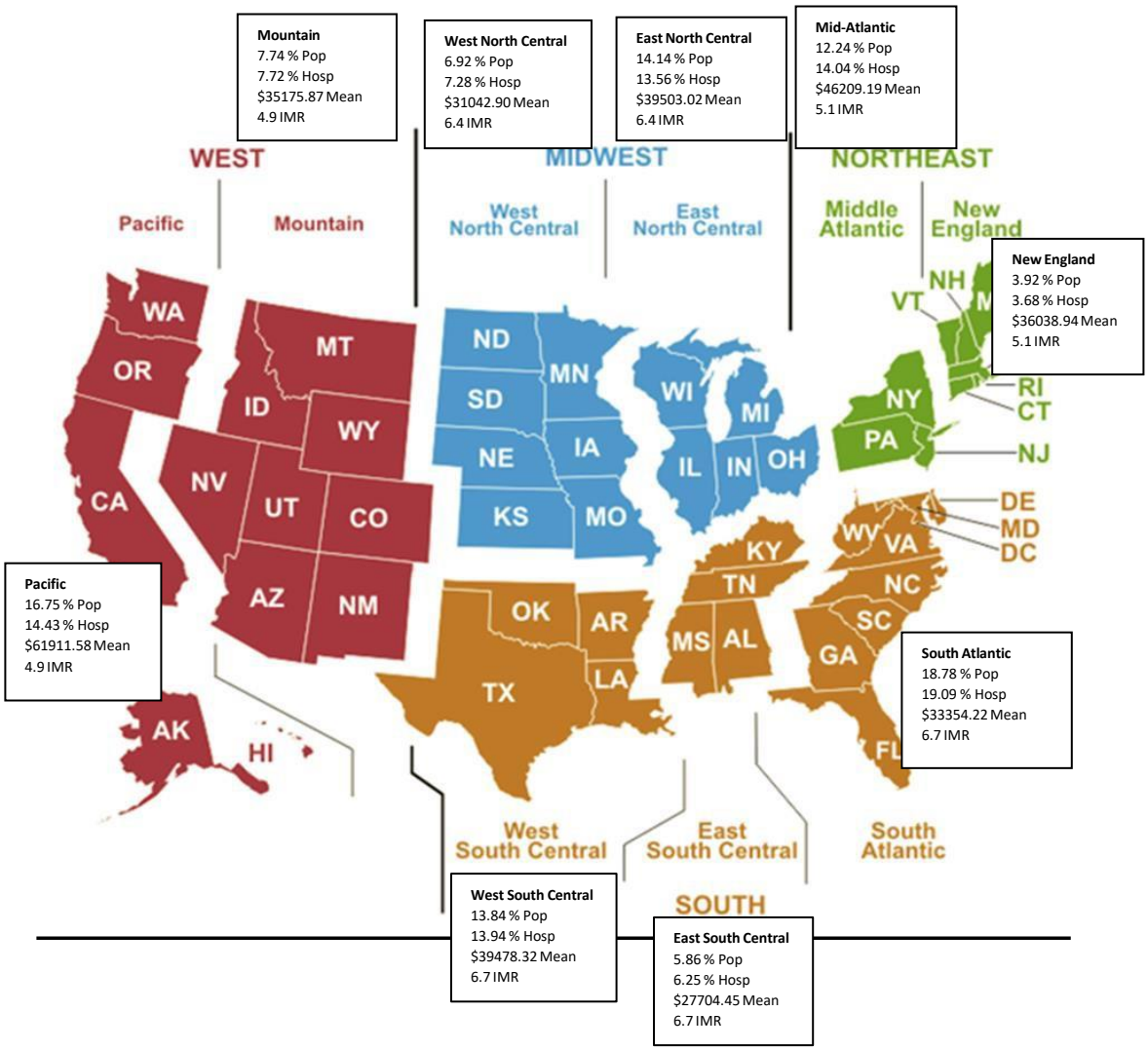


Fig 4 Percent Population, Percent Hospitalization, Mean Charge and Infant Deaths

Source:https://wonder.cdc.gov/controller/datarequest/D140;jsessionid=F8656FCE0594BA29CDF6AECA5FA2D5E6,

https://www.eia.gov/consumption/commercial/maps.php, and Agency for

Healthcare Research and Quality (AHRQ), center for delivery, organization, and markets, HealthCare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS); Hospitalization and Mean Total Charge from my dataset 2012 2013 2014, Infant Population https://datacenter.kidscount.org/data/tables/100-child- population-by-single-age?loc=47&loct=2#detailed/2/2-53/true/869/42/418

Census Divisions are used for the population, hospitalization, and mean total charges from 2012, 2013, 2014. The South division has the highest IMR of 6.7, the Midwest is 6.4 IMR, the Northeast 5.1 and the West has the lowest IMR of 4.9. The census division with the highest population is the South Atlantic and that is also reflected in the number of hospitalizations for infants with almost a fifth (19.09%) of the country's hospitalizations. The Pacific region has the second highest population in the nation, yet it incurs by far the highest mean charge $61,911.58 for hospitalization while the lowest is East South Central at $27,704.45. The New England division has the lowest population by far and almost half as much hospitalization as any other division with mean total charges almost $36,038.94.

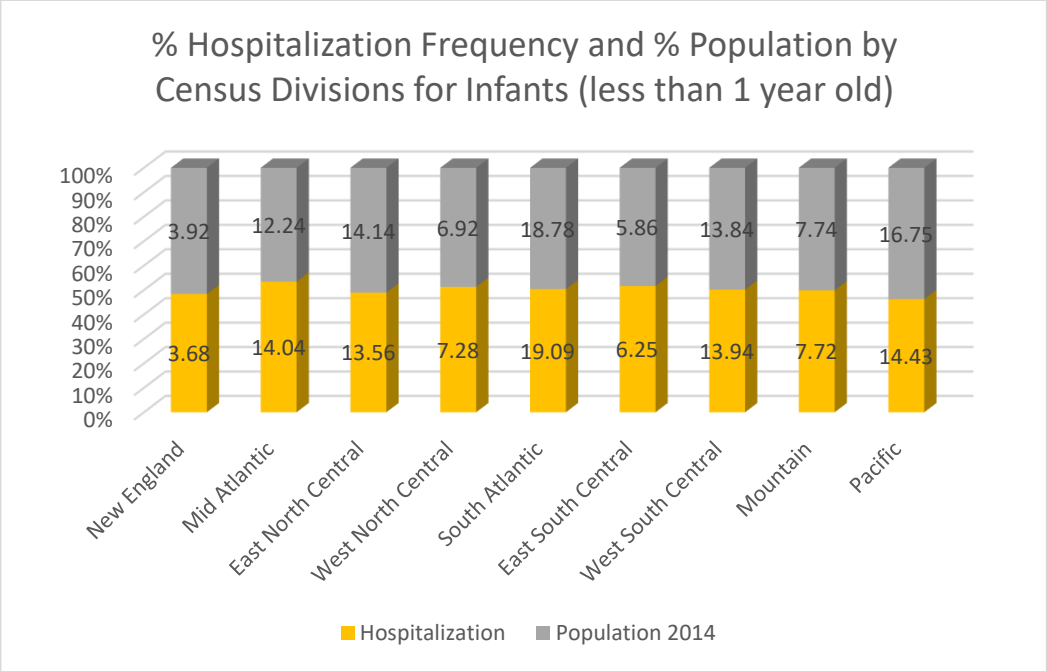


Chart 8 Infant Hospitalization and Population by Census Divisions

Source for population for children https://datacenter.kidscount.org/data/tables/100-child-population-by-single-age?loc=47&loct=2#detailed/2/8,21,23,31,41,47/false/869,36,868/42/418

The percent of infants by region from the national infant population and the corresponding percent of infants hospitalized by frequency for that region are almost proportional. The Mid Atlantic is slightly higher in hospitalization.

The South Atlantic division had 166,395 infant hospital stays while New England had 32,110 infants hospitalized. The numbers of hospitalizations are reflective of the general population census in the divisions. The population in the South Atlantic is 1.53 times that of the Middle Atlantic division, yet the total charges are higher for the Mid-Atlantic at $46,209.19 and South Atlantic $33,354.22.

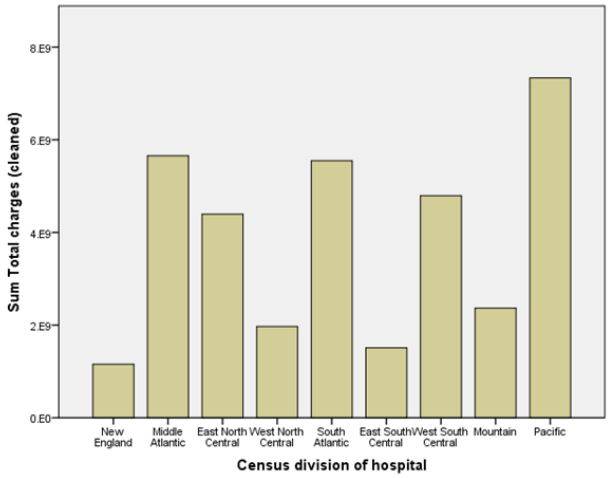


Chart 9 Sum of Total Charges of Hospitalization by Census Divisions

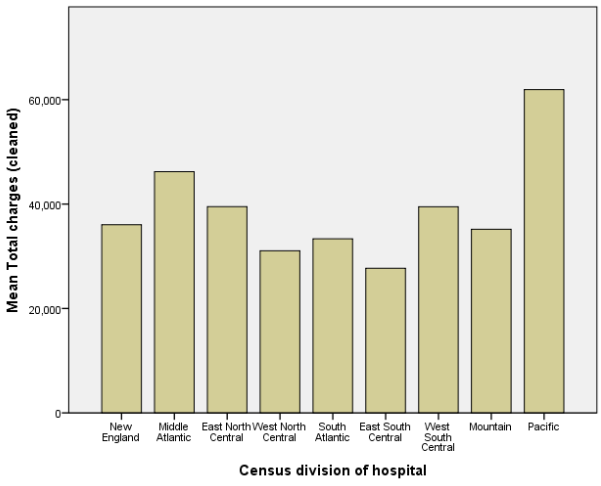


Chart 10 Mean of Total Charges for Hospitalization by Census Divisions

Table 1 Mean and Sum Total Charges by Census Division

Report

Total charges (cleaned)

Census division of hospital	Mean	N	% of Total N	Sum	% of Total Sum
New England	36038.94	32055	3.7%	1155229404	3.3%
Middle Atlantic	46209.19	122405	14.3%	5656236330	16.3%
East North Central	39503.02	111240	13.0%	4394314624	12.7%
West North Central	31042.90	63465	7.4%	1970129587	5.7%
South Atlantic	33354.22	166310	19.4%	5547141609	16.0%
East South Central	27704.45	54485	6.4%	1509478439	4.3%
West South Central	39478.32	121435	14.2%	4794048154	13.8%
Mountain	35175.87	67245	7.8%	2365401276	6.8%
Pacific	61911.58	118490	13.8%	7335901360	21.1%
Total	40516.48	857130	100.0%	34727880784	100.0%

4.3 Hospital Length of Stay

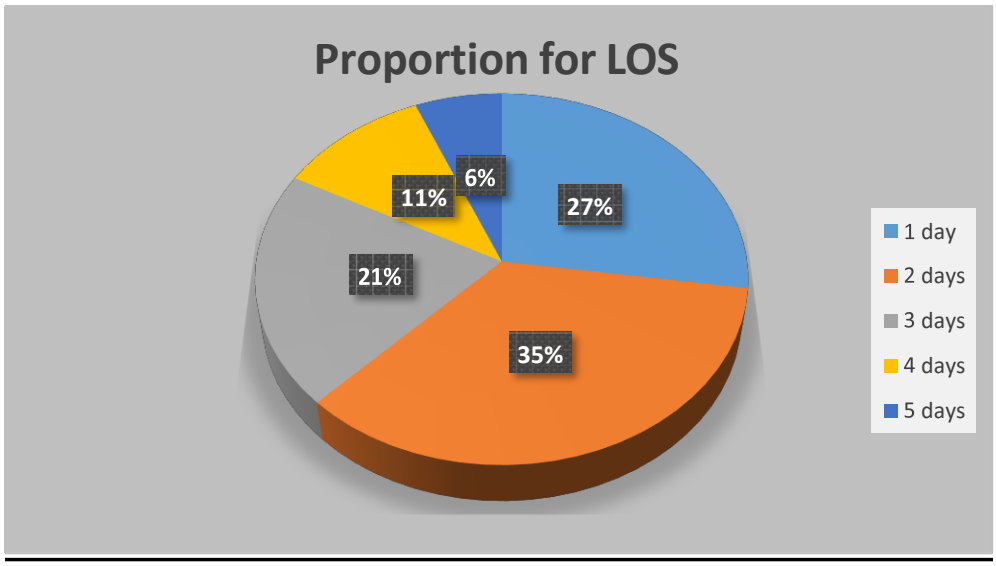


Chart 11 Percent Length of Stay by Frequency for Hospitalization

27% of infants were hospitalized for 1 day, 35% for 2 days, 21% for 3 days, and 11 % for 4 days.

Table 2 Mean a) Length of Stay by Census Division, b) Primary Diagnosis, c) Race, and d) Primary Payer

Report

Length of stay (cleaned)

Census division of hospital	Mean	N	Median
New England	5.29	32110	2.00
Middle Atlantic	4.59	122445	2.00
East North Central	5.10	118240	2.00
West North Central	4.49	63485	2.00
South Atlantic	4.89	166390	2.00
East South Central	4.23	54485	2.00
West South Central	4.65	121515	3.00
Mountain	4.26	67350	2.00
Pacific	4.77	125800	2.00
Total	4.72	871820	2.00

Report

Length of stay (cleaned)

copymostfreqDx	Mean	N	Median
RSV	3.33	119380	3.00
Non RSV	2.98	79200	2.00
Pnemonia	3.06	39430	2.00
Fever unspecified	2.28	25990	2.00
UTI	2.97	25675	2.00
Esophageal	3.70	22845	2.00
Dehydration	2.35	22335	2.00
Total	3.07	334855	2.00

Report

Length of stay (cleaned)

Race (uniform)	Mean	N	Median
White	4.38	371140	2.00
Black	5.17	136760	2.00
Hispanic	4.41	197470	2.00
Asian, Pacific Islander	4.97	25420	2.00
Native	4.88	8360	3.00
Other	5.23	47760	2.00
Total	4.60	786910	2.00

Report

Length of stay (cleaned)

Primary expected payer (uniform)	Mean	N	Median
Medicare	4.67	1915	2.00
Medicaid	4.70	554255	2.00
Private Insurance	4.67	265355	2.00
Self Pay	3.75	17230	2.00
No Charge	4.02	725	2.00
Other	6.04	31125	2.00
Total	4.72	870605	2.00

The mean stay in hospital nationally is 4.7 days, but the median is only 2 days, although the New England region is slightly longer at 5.29, and East North Central is 5.10 days. LOS by primary diagnosis differs for different clinical condition, Acute Bronchiolitis RSV, Pneumonia, and Esophageal Reflux have longer stays of hospitalization. Race also shows different LOS; other and Black races tend to stay longer at 5.23 and 5.17 respectively. LOS by Primary Payer varies slightly as well, with other taking longer in hospital at 6.04 and self-pay getting discharged sooner at 3.75 than other payers. "Other" refers to government programs and various other payers.

However, it was noticeable in the New England region that Native infants with RSV were staying in hospital for a mean of 17 days, unlike in any other region. There were no other Native inpatients in these 7 primary diagnoses for New England.

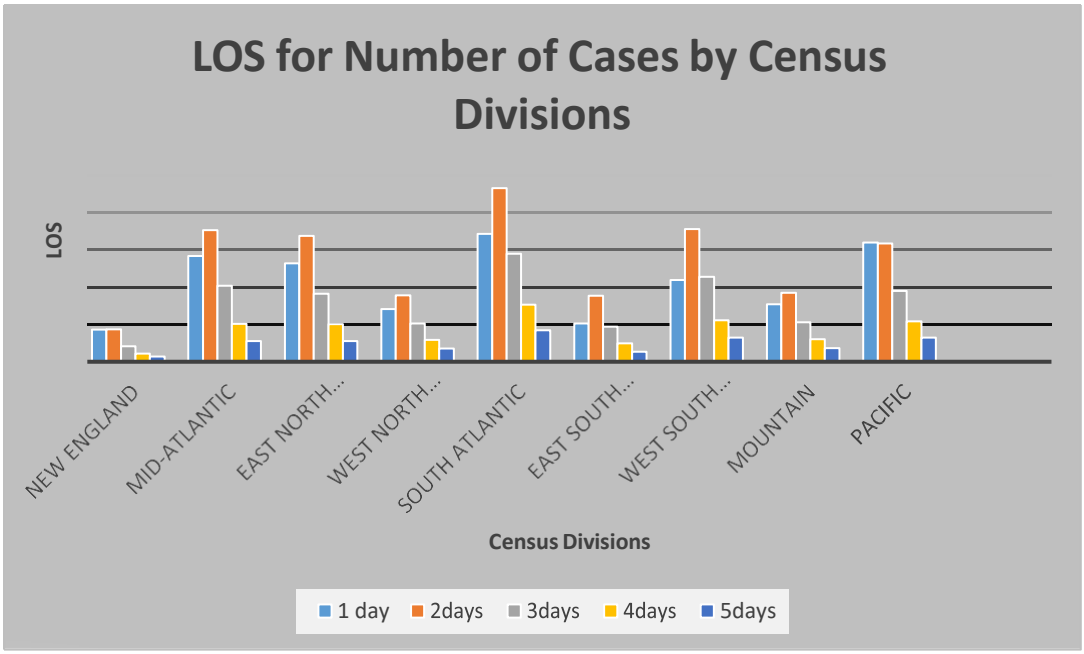


Chart 12 Length of Stay LOS in Hospitalization by Census Divisions

Table 3 Mean and Sum Total Charges for Length of Stay at Hospitalization by Population Census Divisions

Report

Total charges (cleaned)

Census division of hospital	Mean	N	% of Total N	% of Total Sum	Sum
New England	36038.94	32055	3.7%	3.3%	1155229404
Middle Atlantic	46209.19	122405	14.3%	16.3%	5656236330
East North Central	39503.02	111240	13.0%	12.7%	4394314624
West North Central	31042.90	63465	7.4%	5.7%	1970129587
South Atlantic	33354.22	166310	19.4%	16.0%	5547141609
East South Central	27704.45	54485	6.4%	4.3%	1509478439
West South Central	39478.32	121435	14.2%	13.8%	4794048154
Mountain	35175.87	67245	7.8%	6.8%	2365401276
Pacific	61911.58	118490	13.8%	21.1%	7335901360
Total	40516.48	857130	100.0%	100.0%	34727880784

The South Atlantic had the highest volume of inpatient infants with a mean cost of $33354.22 or sum of $5 547 141 609 compared to a national mean of $40516.48 and sum of $34 727 880 784. The lowest mean charge was at East South Central region with $27704.45 and summing $1 509 478 439.

4.3 Emergency Department Analysis

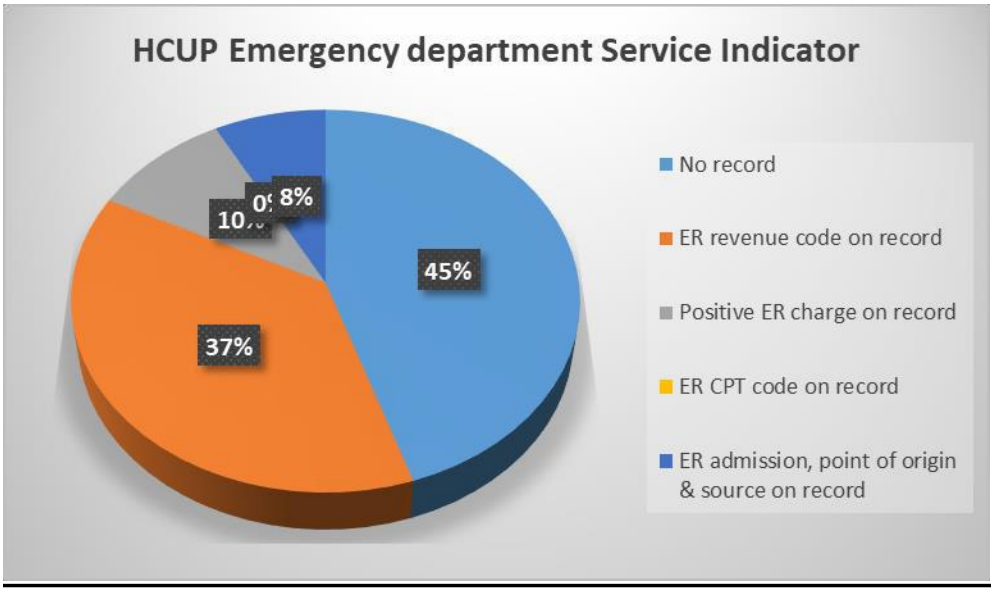


Chart 13. Emergency Department

Descriptive analysis showed that 45% of inpatients did not meet any HCUP criteria for Emergency Department. 37% had one revenue code on record in the Emergency Department. 10% had a positive charge on record.

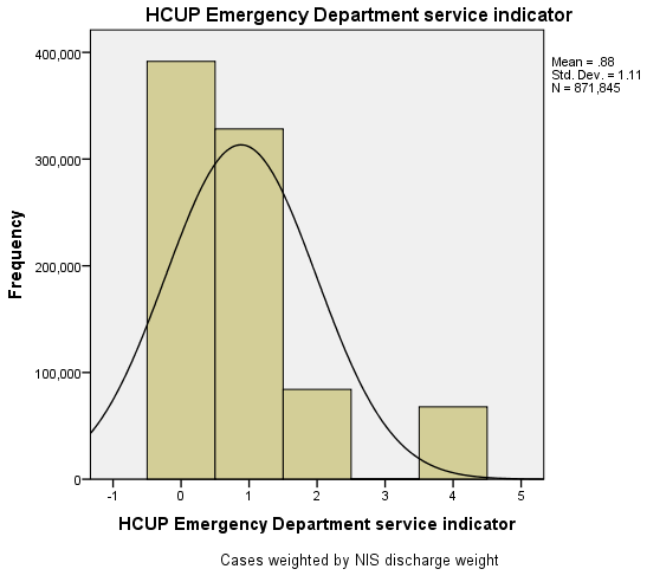


Chart 14 Frequencies for Emergency Department Admissions

Table 3 Admissions by Emergency Department and Census Divisions

Census division of hospital * HCUP Emergency Department service indicator Crosstabulation

Count

		HCUP Emergency Department service indicator					Total
		Record doesnt meet HCUP ED Criteria	ED Revenue Code on Record	Positive ED harge	ED CPT Procedure Code on Record	Condition Code P7	
Census division of hospital	New England	12260	12925	6590	5	330	32110
	Middle Atlantic	39145	83235	0	20	50	122450
	East North Central	66355	29745	7670	0	14480	118250
	West North Central	34320	26115	3005	0	45	63485
	South Atlantic	67205	48000	51110	5	75	166395
	East South Central	21960	32215	0	0	310	54485
	West South Central	52800	68330	0	0	390	121520
	Mountain	37595	14385	15200	0	170	67350
	Pacific	59950	13245	620	0	51985	125800
Total		391590	328195	84195	30	67835	871845

These frequency charts further confirm the initial findings regarding most inpatients not meeting any HCUP criteria for the Emergency Department. The mean charge for Emergency Department hospitalization was $40516.48 nationally for a total of 857130 inpatients totaling $34, 727, 880, 784.

Table 4 Mean and Sum Total Charges by Emergency Department and Census Divisions

Report

Total charges (cleaned)

Census division of hospital	HCUP Emergency Department service indicator	Mean	N	% of Total N	% of Total Sum	Sum
New England	Record doesnt meet HCUP ED Criteria	58030.87	12230	1.4%	2.0%	709718169
	ED Revenue Code on Record	19087.28	12900	1.5%	0.7%	246226067
	Positive ED harge	29587.46	6590	0.8%	0.6%	194981566
	ED CPT Procedure Code on Record	6019.00	5	0.0%	0.0%	30095
	Condition Code P7	12950.01	330	0.0%	0.0%	4273507
	Total	36038.94	32055	3.7%	3.3%	1155229404
Middle Atlantic	Record doesnt meet HCUP ED Criteria	79583.25	39100	4.6%	9.0%	3111704867
	ED Revenue Code on Record	30546.47	83235	9.7%	7.3%	2542535540
	ED CPT Procedure Code on Record	21821.52	20	0.0%	0.0%	436430
	Condition Code P7	31189.90	50	0.0%	0.0%	1559493
	Total	46209.19	122405	14.3%	16.3%	5656236330
East North Central	Record doesnt meet HCUP ED Criteria	51350.87	59345	6.9%	8.8%	3047416192
	ED Revenue Code on Record	26321.83	29745	3.5%	2.3%	782942608
	Positive ED harge	26235.65	7670	0.9%	0.6%	201227447
	Condition Code P7	25050.32	14480	1.7%	1.0%	362728378
	Total	39503.02	111240	13.0%	12.7%	4394314624
West North Central	Record doesnt meet HCUP ED Criteria	38724.97	34305	4.0%	3.8%	1328453636
	ED Revenue Code on Record	22591.31	26115	3.0%	1.7%	589970044
	Positive ED harge	17122.34	3005	0.4%	0.1%	51452614
	Condition Code P7	6332.38	40	0.0%	0.0%	253293
	Total	31042.90	63465	7.4%	5.7%	1970129587
South Atlantic	Record doesnt meet HCUP ED Criteria	48304.93	67125	7.8%	9.3%	3242469053
	ED Revenue Code on Record	20674.77	47995	5.6%	2.9%	992285631
	Positive ED harge	25666.71	51110	6.0%	3.8%	1311825800
	ED CPT Procedure Code on Record	4188.00	5	0.0%	0.0%	20940
	Condition Code P7	7202.46	75	0.0%	0.0%	540185
	Total	33354.22	166310	19.4%	16.0%	5547141609
East South Central	Record doesnt meet HCUP ED Criteria	39137.51	21960	2.6%	2.5%	859461606
	ED Revenue Code on Record	20036.35	32215	3.8%	1.9%	645470841
	Condition Code P7	14664.55	310	0.0%	0.0%	4545992
	Total	27704.45	54485	6.4%	4.3%	1509478439
West South Central	Record doesnt meet HCUP ED Criteria	51318.37	52730	6.2%	7.8%	2706016289
	ED Revenue Code on Record	30436.86	68315	8.0%	6.0%	2079293176
	Condition Code P7	22406.83	390	0.0%	0.0%	8738690
	Total	39478.32	121435	14.2%	13.8%	4794048154
Mountain	Record doesnt meet HCUP ED Criteria	42915.78	37520	4.4%	4.6%	1610201173
	ED Revenue Code on Record	23121.49	14355	1.7%	1.0%	331908113
	Positive ED harge	27656.03	15200	1.8%	1.2%	420371926
	Condition Code P7	17176.76	170	0.0%	0.0%	2920063
	Total	35175.87	67245	7.8%	6.8%	2365401276
Pacific	Record doesnt meet HCUP ED Criteria	90708.34	55150	6.4%	14.4%	5002562738
	ED Revenue Code on Record	32427.32	13245	1.5%	1.2%	429499217
	Positive ED harge	22653.65	620	0.1%	0.0%	14045299
	Condition Code P7	38196.94	49475	5.8%	5.4%	1889794106
	Total	61911.58	118490	13.8%	21.1%	7335901360
Total	Record doesnt meet HCUP ED Criteria	56969.71	379465	44.3%	62.2%	21618003722
	ED Revenue Code on Record	26332.24	328120	38.3%	24.9%	8640131237
	Positive ED harge	26057.42	84195	9.8%	6.3%	2193904652
	ED CPT Procedure Code on Record	16248.84	30	0.0%	0.0%	487465
	Condition Code P7	34833.95	65320	7.6%	6.6%	2275353707
	Total	40516.48	857130	100.0%	100.0%	34727880784

4.5 Hospitalization by Gender

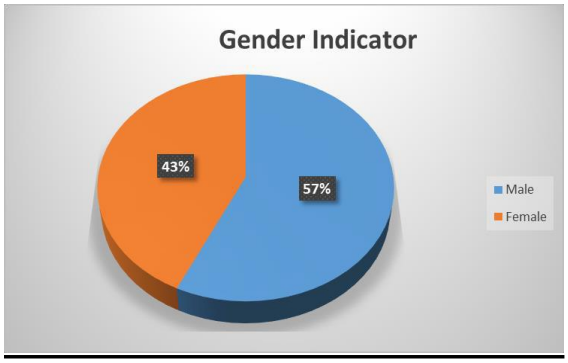


Chart 15. Gender

More than half the admissions were male versus 43% female infants.

4.6 Substance Abuse

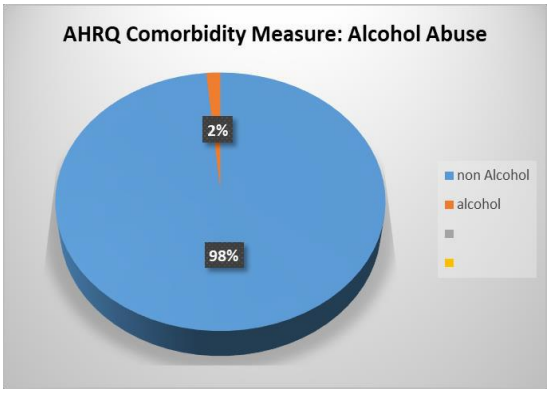


Chart 16. Alcohol Comorbidity

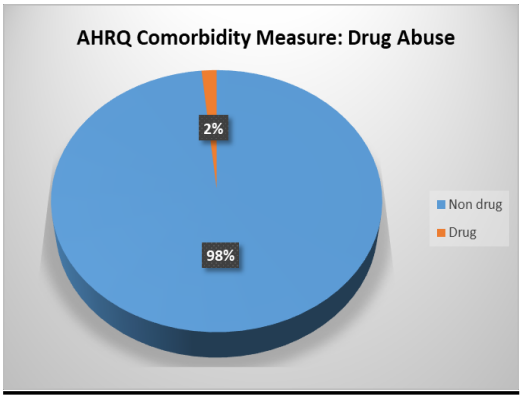


Chart 17. Drug Comorbidity

Almost all patients did not have comorbidity of alcohol or drug abuse.

4.7 Primary Diagnoses

4.7.a Diagnoses Frequency

Frequencies for the primary diagnosis Dx1 are as shown on the graph with ICD-9-CM descriptions to reflect the 10 most frequent diagnosis nationally for inpatients 2012, 2013, 2014 according to HCUP.

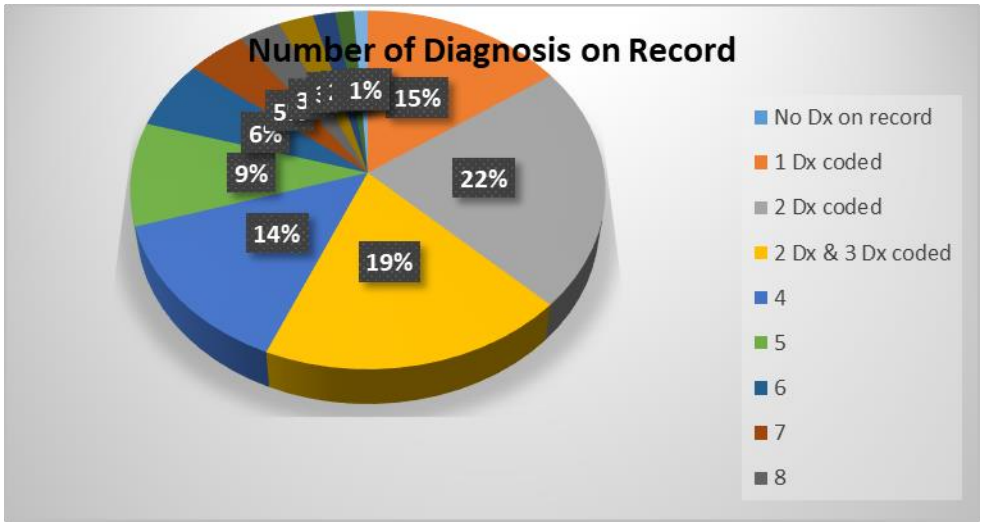


Chart 18. Diagnosis

22% of infants had a second diagnosis coded, 19% had 2nd and 3rd diagnosis coded, and 15% had only the first listed diagnosis coded on record.

4.7.b Number of Diagnoses by Census Divisions

Table 5 Number of Diagnoses by Census Divisions

		No Diagnosis are Coded on Record	Only 1st Diagnosis Coded on Record	2nd Diagnosis Coded on Record	2nd & 3rd Diagnosis Coded on Record
Census division of hospital	New England	10	5715	7280	5435
	Middle Atlantic	0	22520	29195	22970
	East North Central	65	16425	23520	21310
	West North Central	50	7645	12535	11880
	South Atlantic	0	22930	33815	30170
	East South Central	5	7175	11085	9915
	West South Central	85	16455	25420	23200
	Mountain	50	7105	13375	13205
	Pacific	0	20155	27065	21625
Total		265	126125	183290	159710

4.7.c Most Frequent Diagnoses and Main Causes of Hospitalization

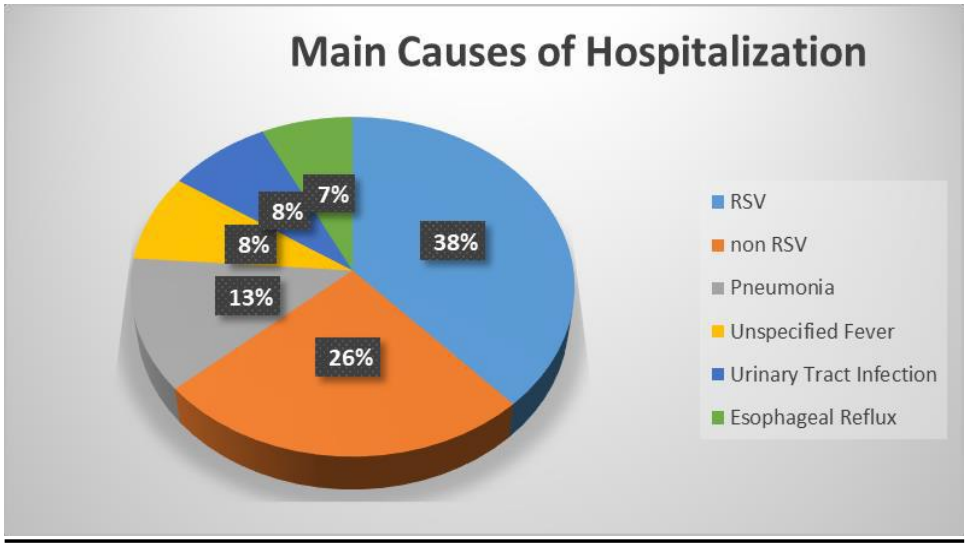


Chart 19 Top Diagnosis in Hospitalization for Infants

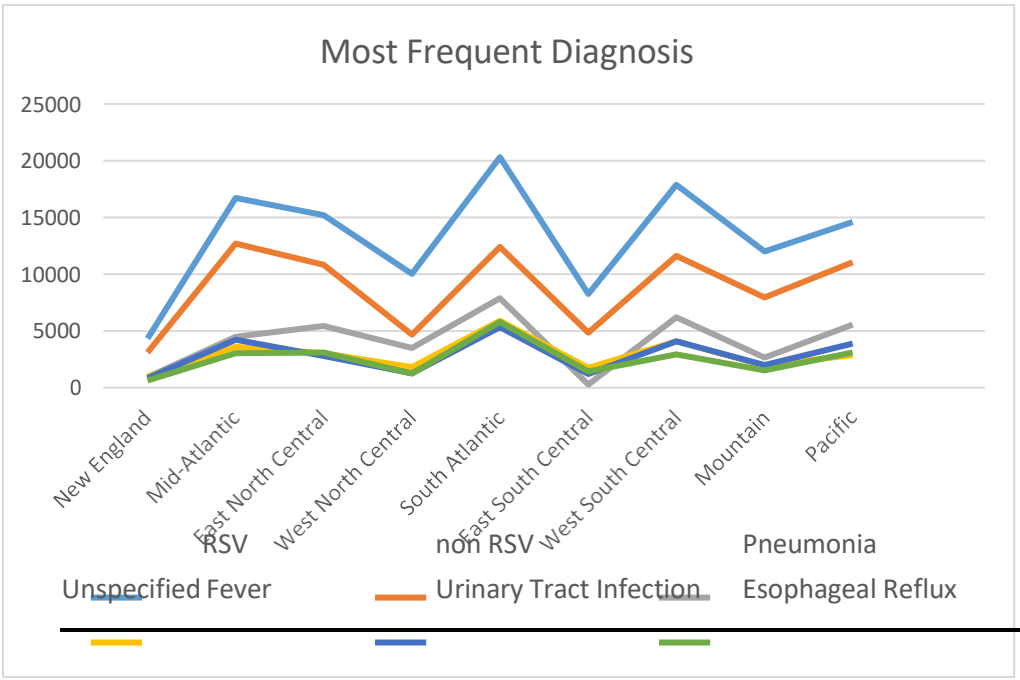


Chart 20 Primary Diagnosis by Census Divisions

RSV is the number one reason for hospitalization of infants across all census regions. It is also proportional in occurrence with the population of the regions in volume.

4.7.d Type of Diagnoses

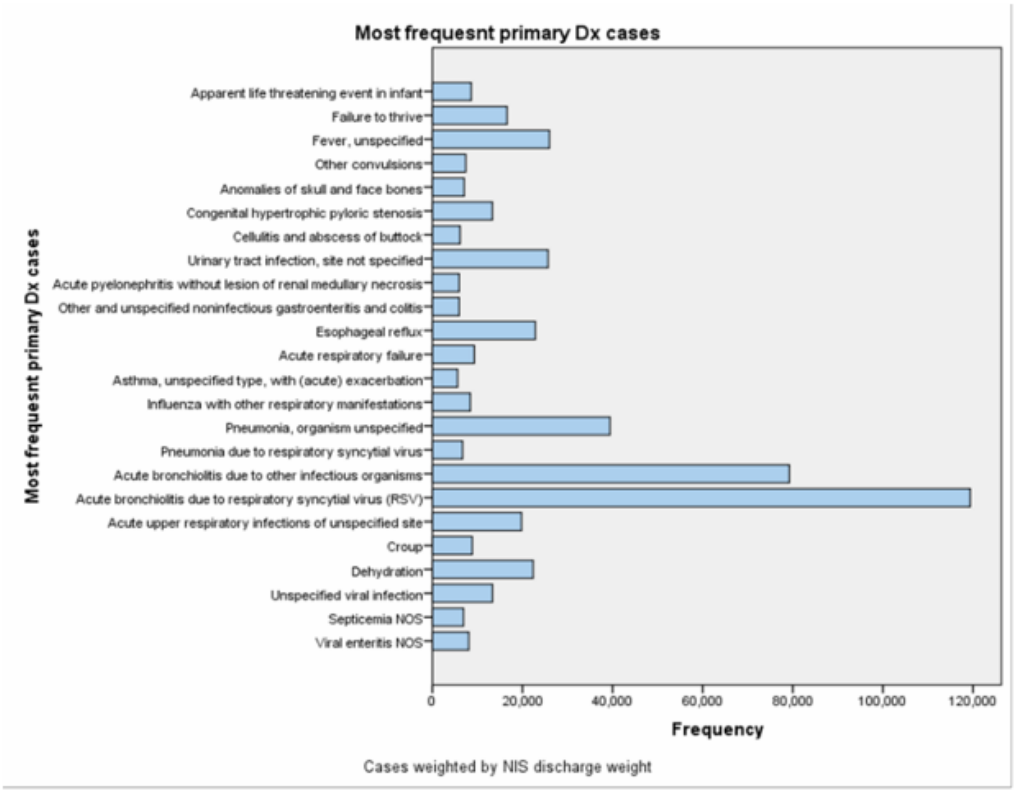


Chart 21 Types of Primary Diagnoses

The most frequent primary diagnosis by far is Acute Bronchiolitis due to Respiratory Syncytial Virus (RSV) followed by Acute Bronchiolitis due to organisms other than RSV. The 3rd most common reason for infant hospitalization is Pneumonia due to unspecified organisms, then Unspecified Fever, followed by Urinary Tract Infection (UTI), and Esophageal Reflux.

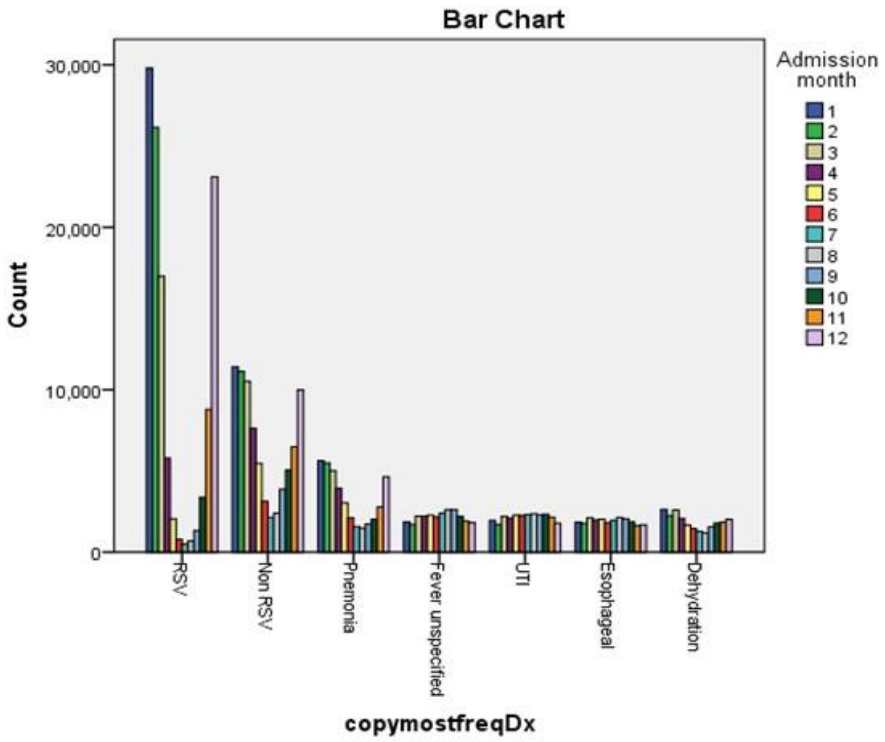


Chart 22 Admissions by Month and Primary Diagnoses

The winter months of December, January, February, and March show higher hospitalization for the top 3 most frequent diagnoses Acute Bronchiolitis RSV, non RSV, and pneumonia.

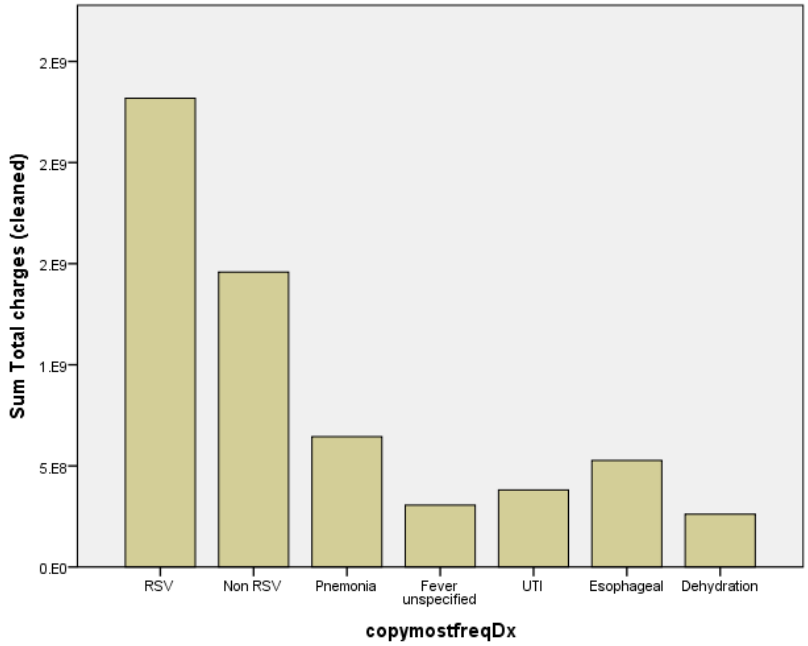


Chart 23 Sum Total Charges by Primary Diagnoses

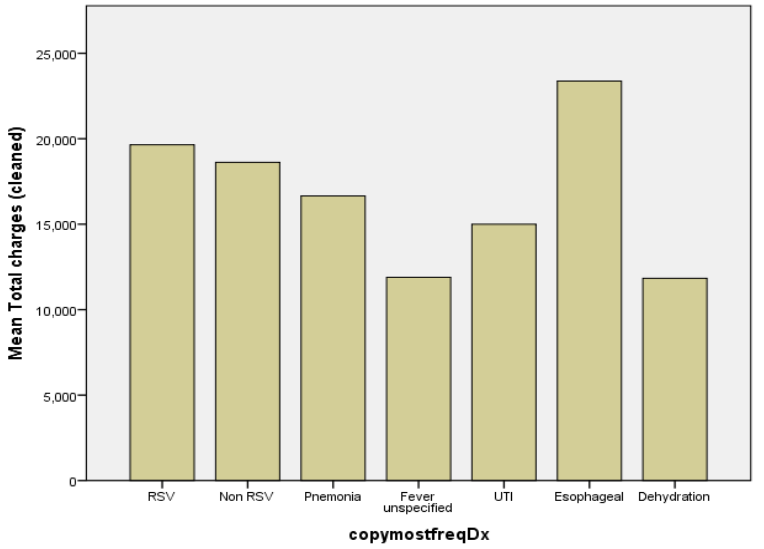


Chart 24 Mean Total charges by Primary Diagnoses

Acute Bronchiolitis RSV had the highest sum charge in reflection of the highest volume or highest frequency of the diagnoses at $2,317,625,502 compared to Esophageal Reflux at

$527,138,509. However, Esophageal Reflux, was more expensive by incident with a mean total charge of $23,371.26 versus RSV at $19,645.90.

4.7.e Total Charges for Most Frequent Primary Diagnoses

Table 6 Total Charges for Hospitalization by Top 7 Primary Diagnosis

Report

Total charges (cleaned)

copymostfreqDx	Mean	N	% of Total N	Sum	% of Total Sum
RSV	19645.90	117970	35.7%	2317625502	39.3%
Non RSV	18623.13	78285	23.7%	1457910891	24.7%
Pnemonia	16652.26	38710	11.7%	644608915	10.9%
Fever unspecified	11888.63	25705	7.8%	305597209	5.2%
UTI	15000.84	25385	7.7%	380796271	6.5%
Esophageal	23371.26	22555	6.8%	527138509	8.9%
Dehydration	11830.94	22095	6.7%	261404513	4.4%
Total	17825.81	330705	100.0%	5895081809	100.0%

Mean total charges were highest for Esophageal Reflux at $23,371.26 and 6.8% cases, while second highest primary diagnoses frequency is RSV at $19,645.90 mean total charge with the highest volume nation-wide at 35.7% of hospitalizations.

The South Atlantic has the highest population and also the highest hospitalizations by diagnoses, followed by West South Central, and then Middle Atlantic. The sum total charges were highest at the Pacific division, followed by Middle Atlantic, and then West South Central.

Table 7 Total Charges for Hospitalization by Top Primary Diagnosis by Census Regions

Report

Total charges (cleaned)

copymostfreqDx	Census division of hospital	Mean	N	% of Total N	Sum	% of Total Sum
RSV	New England	15903.60	4330	1.3%	68862611	1.2%
	Middle Atlantic	24545.64	16710	5.1%	410157571	7.0%
	East North Central	18658.85	14445	4.4%	269526861	4.6%
	West North Central	13725.23	10040	3.0%	137800620	2.3%
	South Atlantic	13975.56	20315	6.1%	283913668	4.8%
	East South Central	12553.35	8265	2.5%	103753685	1.8%
	West South Central	19958.84	17855	5.4%	356364903	6.0%
	Mountain	22605.22	11990	3.6%	271036478	4.6%
	Pacific	29686.83	14020	4.2%	416209106	7.1%
	Total	19645.90	117970	35.7%	2317625502	39.3%
Non RSV	New England	11677.59	3105	0.9%	36258958	0.6%
	Middle Atlantic	20917.21	12700	3.8%	265648482	4.5%
	East North Central	18802.33	10355	3.1%	194698032	3.3%
	West North Central	12963.48	4690	1.4%	60798354	1.0%
	South Atlantic	14691.49	12410	3.8%	182321392	3.1%
	East South Central	10816.26	4850	1.5%	52458971	0.9%
	West South Central	22162.85	11595	3.5%	256978241	4.4%
	Mountain	17547.25	7940	2.4%	139325226	2.4%
	Pacific	25321.75	10640	3.2%	269423235	4.6%
	Total	18623.13	78285	23.7%	1457910891	24.7%
Pnemonia	New England	11814.82	920	0.3%	10869639	0.2%
	Middle Atlantic	19556.49	4480	1.4%	87612994	1.5%
	East North Central	16833.63	4950	1.5%	83326514	1.4%
	West North Central	10859.18	3500	1.1%	38006955	0.6%
	South Atlantic	14305.63	7880	2.4%	112728493	1.9%
	East South Central	11151.86	2785	0.8%	31058022	0.5%
	West South Central	17348.18	6190	1.9%	107385205	1.8%
	Mountain	15473.32	2660	0.8%	41159142	0.7%
	Pacific	24782.40	5345	1.6%	132461950	2.2%
	Total	16652.26	38710	11.7%	644608915	10.9%
Fever unspecified	New England	8795.82	980	0.3%	8619901	0.1%
	Middle Atlantic	14882.71	3600	1.1%	53577772	0.9%
	East North Central	10741.83	2915	0.9%	31312405	0.5%
	West North Central	9755.20	1800	0.5%	17559288	0.3%
	South Atlantic	10089.66	5895	1.8%	59478555	1.0%
	East South Central	9447.49	1755	0.5%	16580341	0.3%
	West South Central	11786.46	4080	1.2%	48088746	0.8%
	Mountain	10872.56	1960	0.6%	21310225	0.4%
	Pacific	18040.42	2720	0.8%	49069975	0.8%
	Total	11888.63	25705	7.8%	305597209	5.2%
UTI	New England	10441.13	840	0.3%	8770547	0.1%
	Middle Atlantic	19785.23	4245	1.3%	83988312	1.4%
	East North Central	11312.00	2675	0.8%	30259584	0.5%
	West North Central	14423.57	1265	0.4%	18245774	0.3%
	South Atlantic	12197.45	5340	1.6%	65134407	1.1%
	East South Central	9050.17	1220	0.4%	11041237	0.2%
	West South Central	13833.16	4085	1.2%	56508450	1.0%
	Mountain	13604.10	1995	0.6%	27140216	0.5%
	Pacific	21426.81	3720	1.1%	79707743	1.4%
	Total	15000.84	25385	7.7%	380796271	6.5%
Esophageal	New England	22067.67	635	0.2%	14012966	0.2%
	Middle Atlantic	24114.17	3045	0.9%	73427611	1.2%
	East North Central	24861.85	2985	0.9%	74212595	1.3%
	West North Central	19046.45	1245	0.4%	23712717	0.4%
	South Atlantic	19281.44	5795	1.8%	111735924	1.9%
	East South Central	17676.65	1430	0.4%	25277612	0.4%
	West South Central	26093.88	2925	0.9%	76324521	1.3%
	Mountain	25999.62	1540	0.5%	40039418	0.7%
	Pacific	29913.79	2955	0.9%	88395145	1.5%
	Total	23371.26	22555	6.8%	527138509	8.9%
Dehydration	New England	9848.74	870	0.3%	8568421	0.1%
	Middle Atlantic	16362.31	3965	1.2%	64876513	1.1%
	East North Central	12262.47	2395	0.7%	29368592	0.5%
	West North Central	8642.08	1880	0.6%	16247022	0.3%
	South Atlantic	10021.25	4095	1.2%	41037033	0.7%
	East South Central	6796.97	1390	0.4%	9447817	0.2%
	West South Central	9891.37	3710	1.1%	36696980	0.6%
	Mountain	9687.01	1380	0.4%	13368071	0.2%
	Pacific	17341.92	2410	0.7%	41794064	0.7%
	Total	11830.94	22095	6.7%	261404513	4.4%
Total	New England	13352.99	11680	3.5%	155963043	2.6%
	Middle Atlantic	21320.95	48745	14.7%	1039289255	17.6%
	East North Central	17502.58	40720	12.3%	712704584	12.1%
	West North Central	12791.66	24420	7.4%	312370730	5.3%
	South Atlantic	13872.50	61730	18.7%	856349472	14.5%
	East South Central	11505.75	21695	6.6%	249617685	4.2%
	West South Central	18603.24	50440	15.3%	938347047	15.9%
	Mountain	18780.88	29465	8.9%	553378775	9.4%
	Pacific	25760.86	41810	12.6%	1077061219	18.3%
	Total	17825.81	330705	100.0%	5895081809	100.0%

Table 8 Total Charges by Primary Diagnosis for by Year 2012, 2013, 2014

Report

Total charges (cleaned)

copymostfreqDx	Calendar year	Mean	N	% of Total N	Sum	% of Total Sum
RSV	2012	17024.12	46570	14.1%	792813044	13.4%
	2013	20885.23	42030	12.7%	877805625	14.9%
	2014	22029.52	29370	8.9%	647006833	11.0%
	Total	19645.90	117970	35.7%	2317625502	39.3%
Non RSV	2012	15246.18	28530	8.6%	434973555	7.4%
	2013	19909.34	25680	7.8%	511271284	8.7%
	2014	21253.01	24075	7.3%	511666051	8.7%
	Total	18623.13	78285	23.7%	1457910891	24.7%
Pnemonia	2012	15120.27	14930	4.5%	225745781	3.8%
	2013	16537.88	13400	4.1%	221607539	3.8%
	2014	19003.44	10380	3.1%	197255595	3.3%
	Total	16652.26	38710	11.7%	644608915	10.9%
Fever unspecified	2012	11132.01	9975	3.0%	111041852	1.9%
	2013	11693.20	8350	2.5%	97638076	1.7%
	2014	13132.42	7380	2.2%	96917281	1.6%
	Total	11888.63	25705	7.8%	305597209	5.2%
UTI	2012	14195.75	8940	2.7%	126910016	2.2%
	2013	14889.99	8555	2.6%	127383793	2.2%
	2014	16033.27	7890	2.4%	126502462	2.1%
	Total	15000.84	25385	7.7%	380796271	6.5%
Esophageal	2012	23633.14	8185	2.5%	193437179	3.3%
	2013	21732.59	7405	2.2%	160929596	2.7%
	2014	24805.71	6965	2.1%	172771734	2.9%
	Total	23371.26	22555	6.8%	527138509	8.9%
Dehydration	2012	10656.49	8105	2.5%	86370774	1.5%
	2013	12300.83	7785	2.4%	95761911	1.6%
	2014	12775.47	6205	1.9%	79271828	1.3%
	Total	11830.94	22095	6.7%	261404513	4.4%
Total	2012	15740.74	125235	37.9%	1971292200	33.4%
	2013	18483.28	113205	34.2%	2092397825	35.5%
	2014	19849.26	92265	27.9%	1831391785	31.1%
	Total	17825.81	330705	100.0%	5895081809	100.0%

35% of inpatients were diagnosed with RSV and they incurred 39.3% of the cost of hospitalization. This was followed by non RSV and Pneumonia respectively with 23.7% and 11.7% occurrence and sum charge of 24.7% and 10.9%. The total number of hospitalization due to these diagnoses decreased from 2012 at 37.9% to 2014 at 27.9% with a simultaneous reduction of cost from 33.4% to 31.1%.

4.8 Mortality and Risk of Mortality

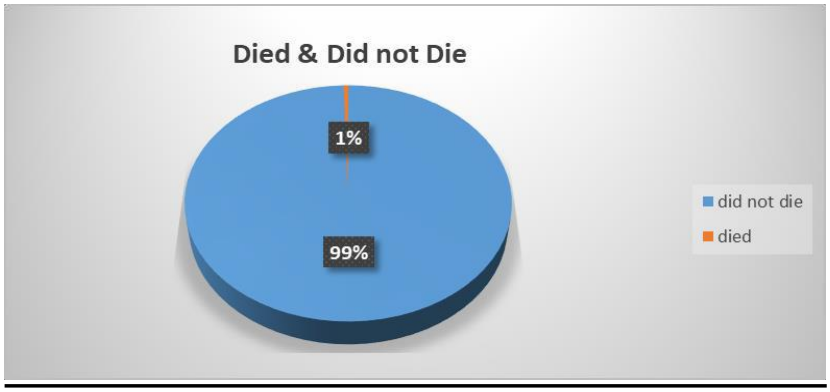


Chart 25. Died During Hospitalization

There was a total of 871845 cases with a 95% confidence interval, there were 1% deaths.

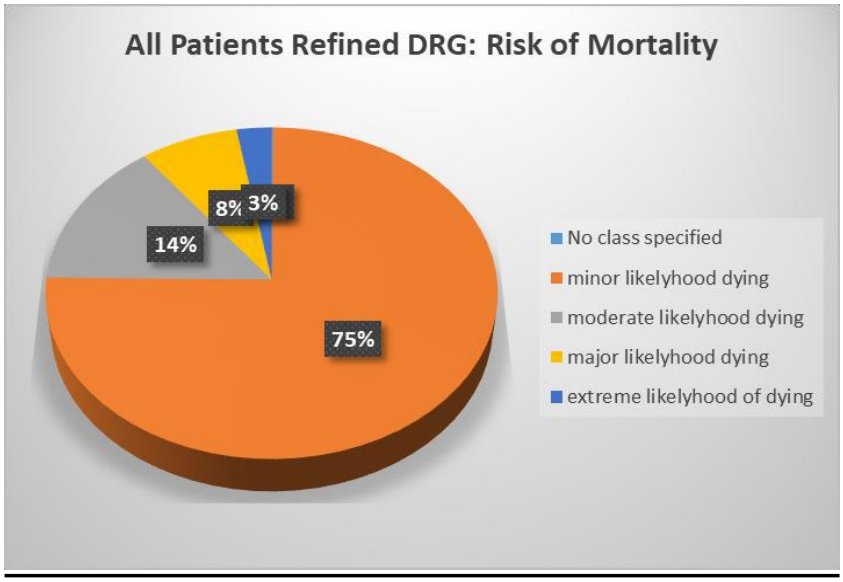


Chart 26. Risk of Mortality

Three quarters of the infants had minor likelihood of dying and 14% had moderate likelihood of dying. In general, the patients had a low risk of dying. This was true throughout the various census divisions as seen below.

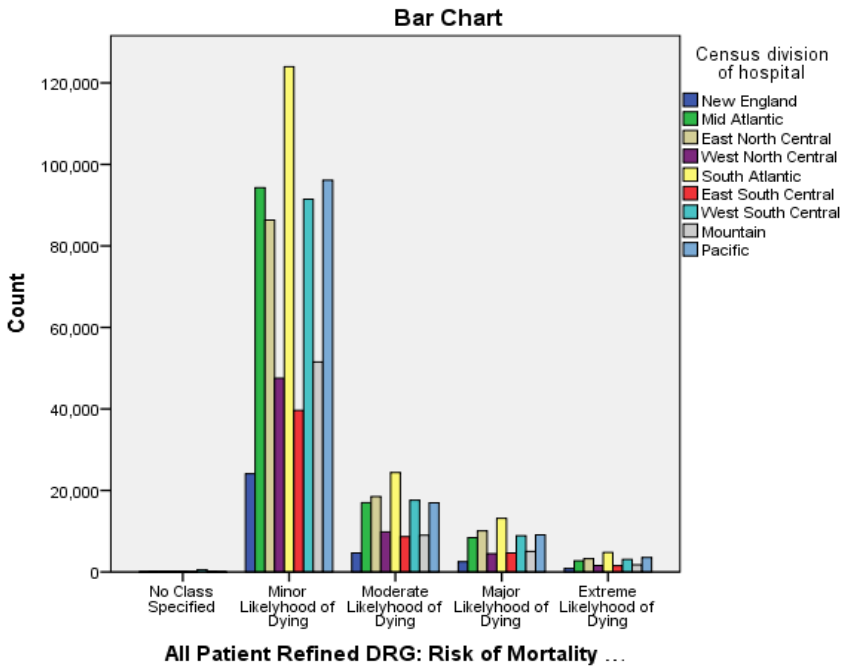


Chart 27. Risk of Mortality in Hospitalization by Census Divisions

Table 9 Mean and Sum Total Charges for Hospitalization by Risk of Mortality and Census Divisions

Census Division	Mean Charge	Cases Number	%N	Sum Charge
New England	13352.99	11680	3.5	155963043
Middle Atlantic	21320.95	48745	14.7	1039289255
East North Central	17502.58	40720	12.3	712704584
West North Central	12791.66	24420	7.4	312370730
South Atlantic	13872.50	61730	18.7	856349472
East South Central	11505.75	21695	6.6	249617685
West South Central	18603.24	50440	15.3	938347047
Mountain	18780.88	29465	8.9	553378775
Pacific	25760.86	41810	12.6	1077061219
Total	17825.81	330705	100	5895081809

4.9 **Severity of Illness**

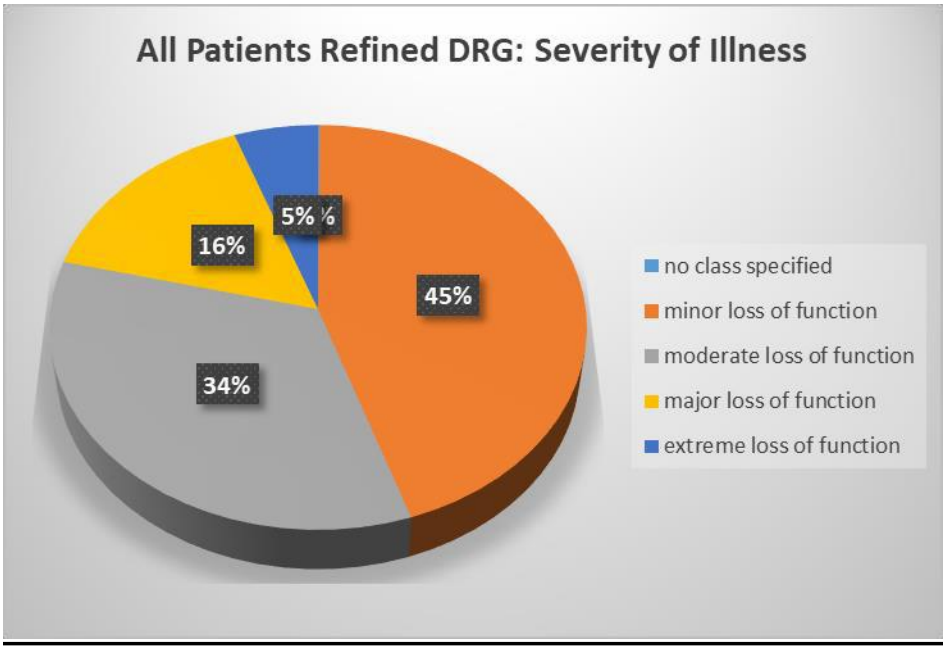


Chart 28. Severity of Illness

45% of the patients exhibited minor loss of function & over a third (34%) showed moderate loss of function in terms of severity of illness, while 16% had major loss of function. Hospitalization of all patients refined DRG by severity of illness was similar throughout the census divisions. This is also reflected in the mean total charge.

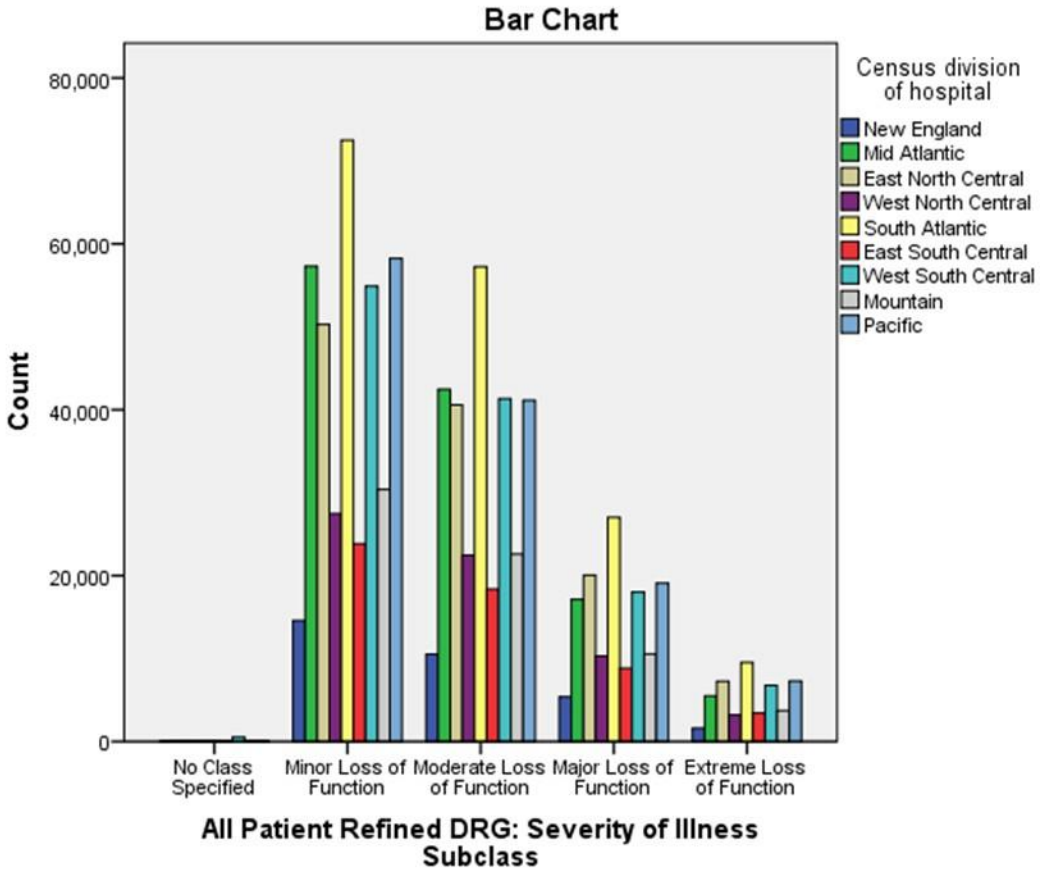


Chart 29 Severity of Illness in Hospitalization by Census Divisions

Table 10 Mean & Total Charges by Diagnosis for Severity of Illness

Report

Total charges (cleaned)

copymostfreqDx	All Patient Refined DRG: Severity of Illness Subclass	Mean	N	Std. Deviation	% of Total N	% of Total Sum	Sum
RSV	No Class Specified	12758.66	70	13404.117	0.0%	0.0%	893105
	Minor Loss of Function	14809.23	58575	35351.076	17.7%	14.7%	867450189
	Moderate Loss of Function	20369.72	41365	71582.483	12.5%	14.3%	842592827
	Major Loss of Function	28518.40	14270	55487.660	4.3%	6.9%	406957554
	Extreme Loss of Function	54127.86	3690	114600.369	1.1%	3.4%	199731826
	Total	19645.90	117970	57086.886	35.7%	39.3%	2317625502
Non RSV	No Class Specified	10034.77	45	10944.160	0.0%	0.0%	451565
	Minor Loss of Function	13539.04	37770	46426.454	11.4%	8.7%	511369077
	Moderate Loss of Function	17067.17	28390	28949.373	8.6%	8.2%	484536817
	Major Loss of Function	26491.15	9685	46492.581	2.9%	4.4%	256566738
	Extreme Loss of Function	85589.41	2395	290159.163	0.7%	3.5%	204986694
	Total	18623.13	78285	65910.648	23.7%	24.7%	1457910891
Pnemonia	No Class Specified	11570.66	15	2837.353	0.0%	0.0%	173561
	Minor Loss of Function	13712.26	18280	16412.976	5.5%	4.3%	250660077
	Moderate Loss of Function	16131.24	14535	20632.193	4.4%	4.0%	234467540
	Major Loss of Function	22077.21	4765	43166.811	1.4%	1.8%	105198039
	Extreme Loss of Function	48528.88	1115	163284.732	0.3%	0.9%	54109698
	Total	16652.26	38710	36342.217	11.7%	10.9%	644608915
Fever unspecified	No Class Specified	8346.26	20	4398.582	0.0%	0.0%	166925
	Minor Loss of Function	10699.88	14970	7735.140	4.5%	2.7%	160177124
	Moderate Loss of Function	12371.65	7300	13652.742	2.2%	1.5%	90313021
	Major Loss of Function	14257.97	2785	20439.825	0.8%	0.7%	39708446
	Extreme Loss of Function	24177.29	630	46735.877	0.2%	0.3%	15231692
	Total	11888.63	25705	13845.496	7.8%	5.2%	305597209
UTI	No Class Specified	9902.44	25	2879.442	0.0%	0.0%	247559
	Minor Loss of Function	13407.21	13080	18218.866	4.0%	3.0%	175366333
	Moderate Loss of Function	15098.71	8685	12235.782	2.6%	2.2%	131132288
	Major Loss of Function	19735.38	2975	24766.723	0.9%	1.0%	58712795
	Extreme Loss of Function	24737.56	620	40376.978	0.2%	0.3%	15337296
	Total	15000.84	25385	18443.181	7.7%	6.5%	380796271
Esophageal	No Class Specified	22497.63	25	20452.538	0.0%	0.0%	562440
	Minor Loss of Function	16557.40	8985	46376.780	2.7%	2.5%	148768181
	Moderate Loss of Function	20895.59	9445	33454.185	2.9%	3.3%	197358747
	Major Loss of Function	34702.41	3380	54898.178	1.0%	2.0%	117294063
	Extreme Loss of Function	87715.44	720	144408.772	0.2%	1.1%	63155078
	Total	23371.26	22555	51133.302	6.8%	8.9%	527138509
Dehydration	No Class Specified	2996.00	15	932.855	0.0%	0.0%	44940
	Minor Loss of Function	9217.75	10415	8929.704	3.1%	1.6%	96002808
	Moderate Loss of Function	11515.22	8115	14828.593	2.5%	1.6%	93445955
	Major Loss of Function	18915.03	2905	51453.459	0.9%	0.9%	54948092
	Extreme Loss of Function	26298.75	645	72291.189	0.2%	0.3%	16962718
	Total	11830.94	22095	25192.528	6.7%	4.4%	261404513
Total	No Class Specified	11814.41	215	12409.616	0.1%	0.0%	2540096
	Minor Loss of Function	13634.40	162075	33823.081	49.0%	37.5%	2209793789
	Moderate Loss of Function	17599.59	117835	46788.513	35.6%	35.2%	2073847195
	Major Loss of Function	25497.01	40765	48442.478	12.3%	17.6%	1039385726
	Extreme Loss of Function	58024.95	9815	176323.750	3.0%	9.7%	569515003
	Total	17825.81	330705	51152.192	100.0%	100.0%	5895081809

4.10.a Chronic Conditions

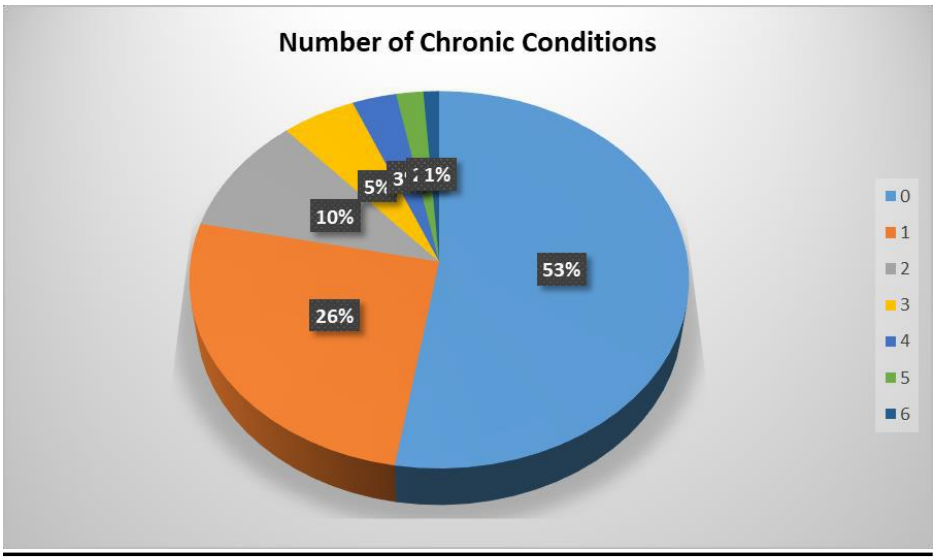


Chart 30. Chronic Conditions

A little more than half the patients (53%) were free of any chronic condition and 26% only had one chronic condition, while only 10% had 2 conditions.

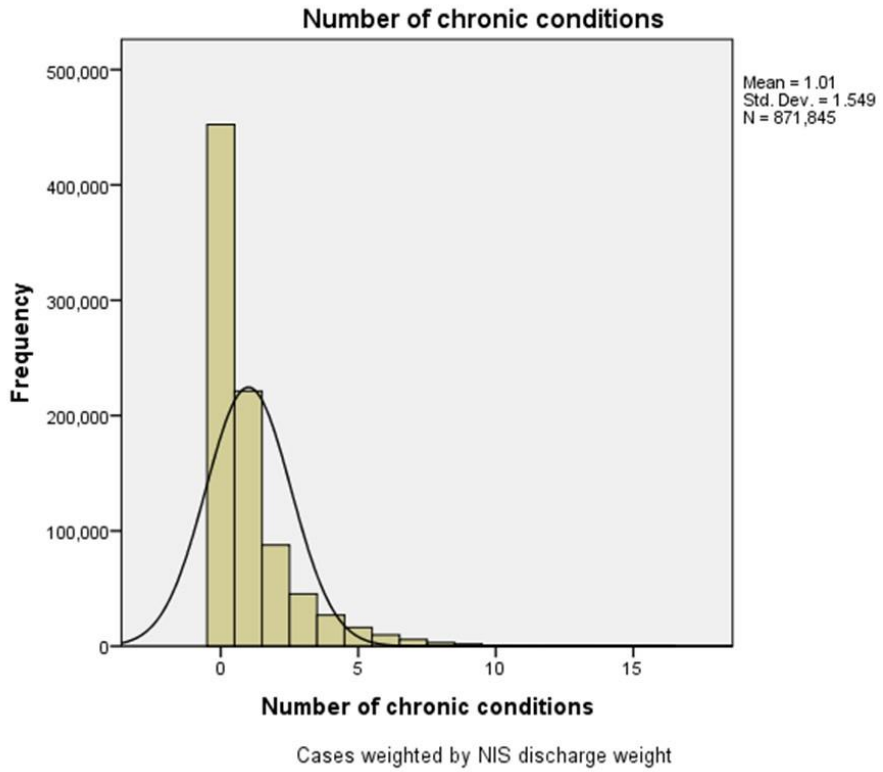


Chart 31 Number of Chronic Conditions

Table 11 Frequencies of Chronic Conditions by Census Divisions

Census division of hospital

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	New England	32110	3.7	3.7	3.7
	Middle Atlantic	122450	14.0	14.0	17.7
	East North Central	118250	13.6	13.6	31.3
	West North Central	63485	7.3	7.3	38.6
	South Atlantic	166395	19.1	19.1	57.7
	East South Central	54485	6.2	6.2	63.9
	West South Central	121520	13.9	13.9	77.8
	Mountain	67350	7.7	7.7	85.6
	Pacific	125800	14.4	14.4	100.0
	Total	871845	100.0	100.0	

4.10.b Chronic Conditions by Body System

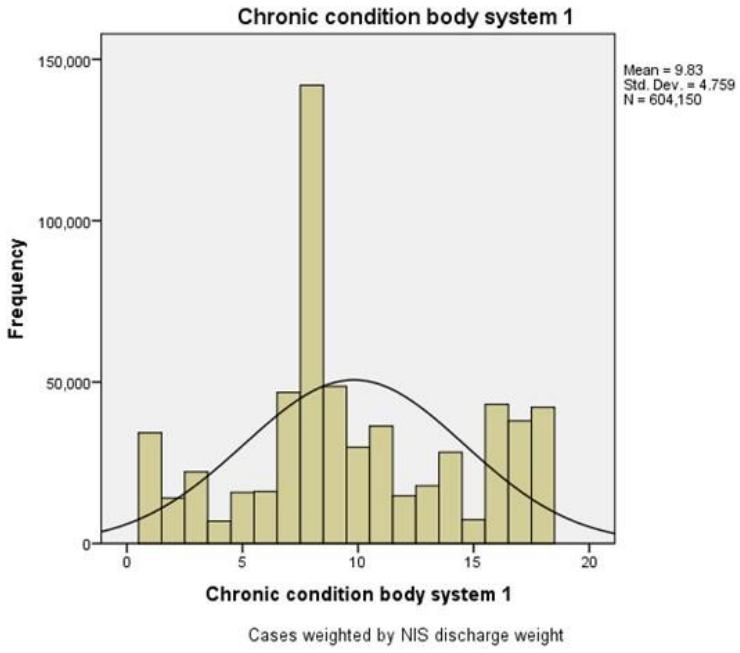


Chart 32 Frequency Analysis for Chronic Conditions by Body System

The most frequent chronic condition by body system was 16.3% Respiratory.

Table 12 Frequency Analysis for Chronic Conditions by Body System

Chronic condition body system 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Infectious & Parasitic	34290	3.9	5.7	5.7
	Neoplasm	14080	1.6	2.3	8.0
	Endocrine	22155	2.5	3.7	11.7
	Blood Disorders	6900	.8	1.1	12.8
	Mental Disorders	15785	1.8	2.6	15.4
	Nervous System & Sense Organs	16105	1.8	2.7	18.1
	Circulatory	46765	5.4	7.7	25.8
	Respiratory	141925	16.3	23.5	49.3
	Digestive	48680	5.6	8.1	57.4
	Genitourinary	29820	3.4	4.9	62.3
	Pregnancy, Child Birth, Puerperium	36335	4.2	6.0	68.3
	Skin & Subcutaneous	14730	1.7	2.4	70.8
	Musculoskeletal	17835	2.0	3.0	73.7
	Congenital Anomalies	28220	3.2	4.7	78.4
	Perinatal Originating Disease	7335	.8	1.2	79.6
	Symptoms, Signs, Ill Defined Conditions	43090	4.9	7.1	86.7
	Injury & Poisoning	37950	4.4	6.3	93.0
	Factors Influencing Health Status & Contact with Health Services	42150	4.8	7.0	100.0
	Total	604150	69.3	100.0	
Missing	System	267695	30.7		
Total		871845	100.0		

Table 13 Mean Total Charges of Hospitalization by Chronic Pulmonary Disease for Top 7 Primary Diagnosis

copymostfreqDx	AHRQ comorbidity measure: Chronic pulmonary disease	Mean	N	Std. Deviation	% of Total N
RSV	0	19775.03	110555	58305.908	33.4%
	1	17720.57	7415	34027.168	2.2%
	Total	19645.90	117970	57086.886	35.7%
Non RSV	0	18530.09	73825	65711.979	22.3%
	1	20163.19	4460	69105.754	1.3%
	Total	18623.13	78285	65910.648	23.7%
Pnemonia	0	16672.11	33120	38497.202	10.0%
	1	16534.64	5590	19112.433	1.7%
	Total	16652.26	38710	36342.217	11.7%
Fever unspecified	0	11865.62	24125	13151.966	7.3%
	1	12240.01	1580	21857.402	0.5%
	Total	11888.63	25705	13845.496	7.8%
UTI	0	15103.33	24005	18713.293	7.3%
	1	13218.08	1380	12740.974	0.4%
	Total	15000.84	25385	18443.181	7.7%
Esophageal	0	23269.61	21095	50657.143	6.4%
	1	24840.03	1460	57574.713	0.4%
	Total	23371.26	22555	51133.302	6.8%
Dehydration	0	11839.60	20505	25656.757	6.2%
	1	11719.21	1590	18178.236	0.5%
	Total	11830.94	22095	25192.528	6.7%
Total	0	17865.60	307230	51876.271	92.9%
	1	17304.99	23475	40496.759	7.1%
	Total	17825.81	330705	51152.192	100.0%

Hospitalization for infants with chronic pulmonary disease mirrored that of patients with RSV, non RSV and Pneumonia.

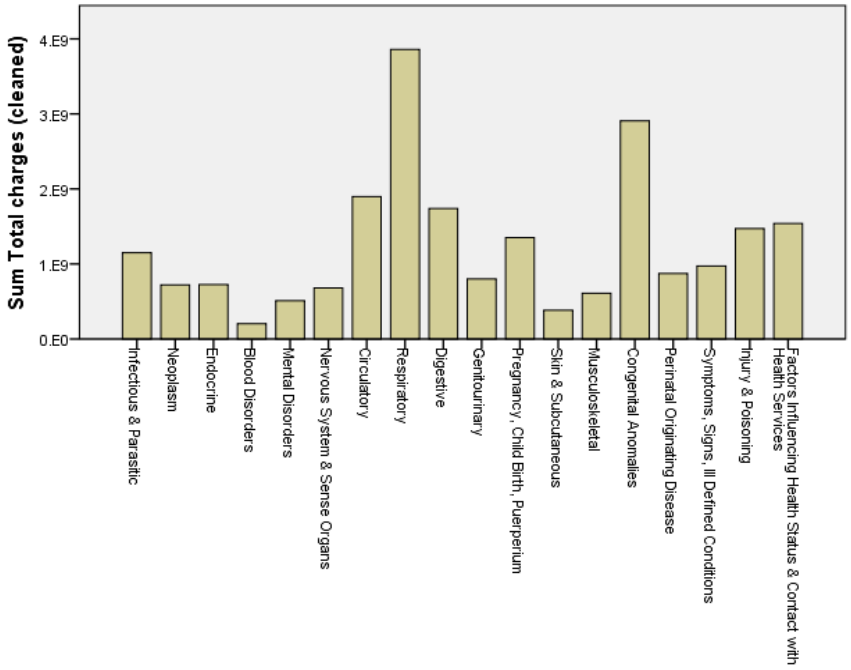


Chart 33 Sum Total charges by Most Frequent Chronic Condition

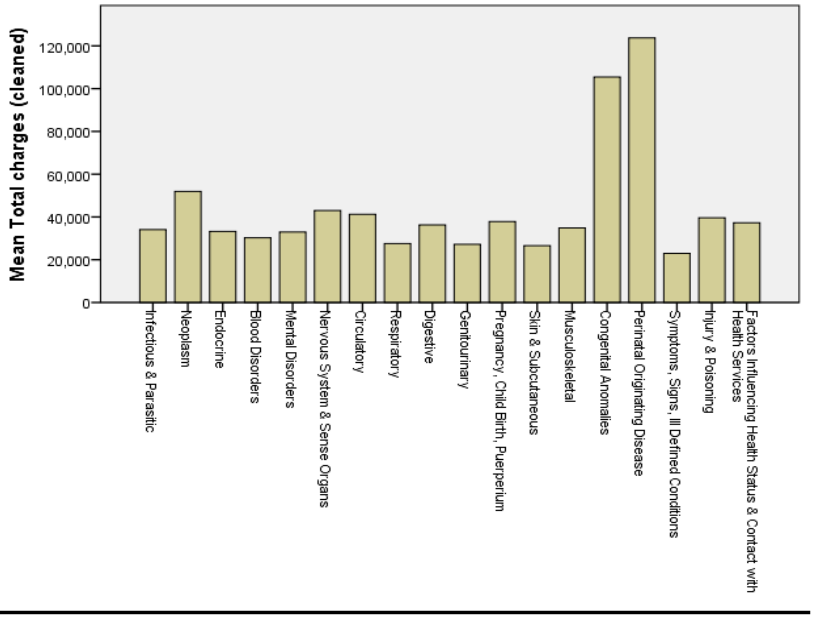


Chart 34 Mean Total Charges by Most Frequent Chronic Condition

4.11 Procedures During Hospitalization

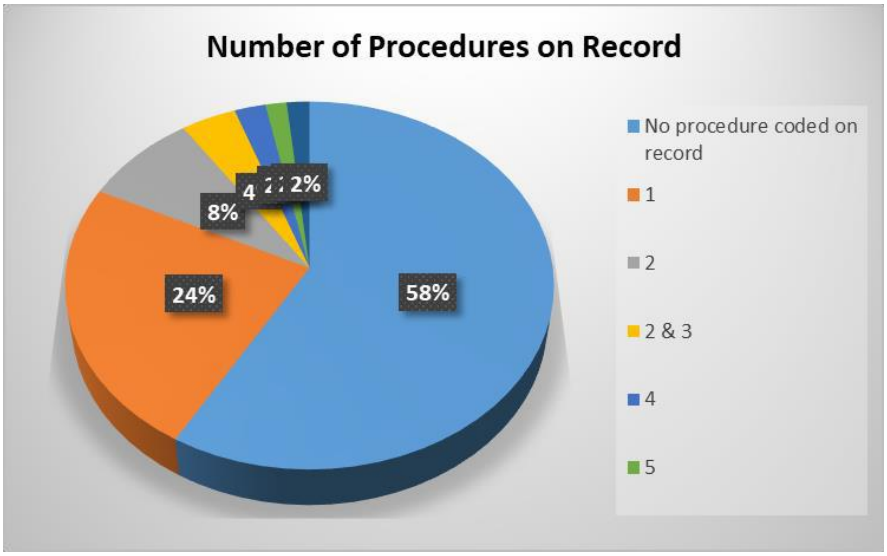


Chart 35. Procedures

58% of inpatients had no procedure coded on discharge, and 24% had only 1 procedure coded on record, and 8% had 2 procedures coded.

Table 14 Number of Procedures by Census Divisions

		No Procedure Coded on Record	1st Procedure Coded on Record	2nd Procedure Coded on Record	2nd & 3rd Procedure Coded on Record
Census division of hospital	New England	17715	7295	2490	1365
	Middle Atlantic	57845	34650	12620	6450
	East North Central	68735	25040	8875	4725
	West North Central	40650	11875	3920	2225
	South Atlantic	99095	37270	11550	5765
	East South Central	33190	11865	3255	2060
	West South Central	78070	25305	6880	3425
	Mountain	42615	13275	4135	2605
	Pacific	57690	35215	16630	5570
Total		495605	201790	70355	34190

Table 15 Procedures Done During Hospitalization and Mean and Sum Charges

Report

Total charges (cleaned)

TopTenProcedures	Mean	N	% of Total N	Sum	% of Total Sum
All Else	39657.23	714170	83.3%	28321996015	81.6%
Spinal Tap	20591.84	64200	7.5%	1321995997	3.8%
Pyloromyotomy	22451.81	15695	1.8%	352381095	1.0%
Skin & Subcutaneous Tissue Incision	18902.04	11435	1.3%	216144728	0.6%
Respiratory Medication Administered by Nebulizer	18528.40	9715	1.1%	180003461	0.5%
Enterel Infusion of Conc Nutritional Substance	43991.87	9440	1.1%	415283157	1.2%
Continuous Invasive Mechanical Ventilation >=96hr	310321.39	9190	1.1%	2851852124	8.2%
Continuous Invasive Mechanical Ventilation < 96hr	76739.66	8465	1.0%	649600966	1.9%
Other Puncture of Vein	24487.04	7605	0.9%	186223921	0.5%
Electroencephalographic Monitoring by Video & Radion	32210.58	7215	0.8%	232399319	0.7%
Total	40516.48	857130	100.0%	34727880784	100.0%

These are the top ten procedures most frequently carried out when those 24% of inpatients require a single procedure. Spinal tap is the most frequently of those and is done at 7.5% of cases with a mean total charge of $20, 591.84. However, the most expensive mean total charge is $310,321.39 for continuous invasive mechanical ventilation for 96 hours or more.

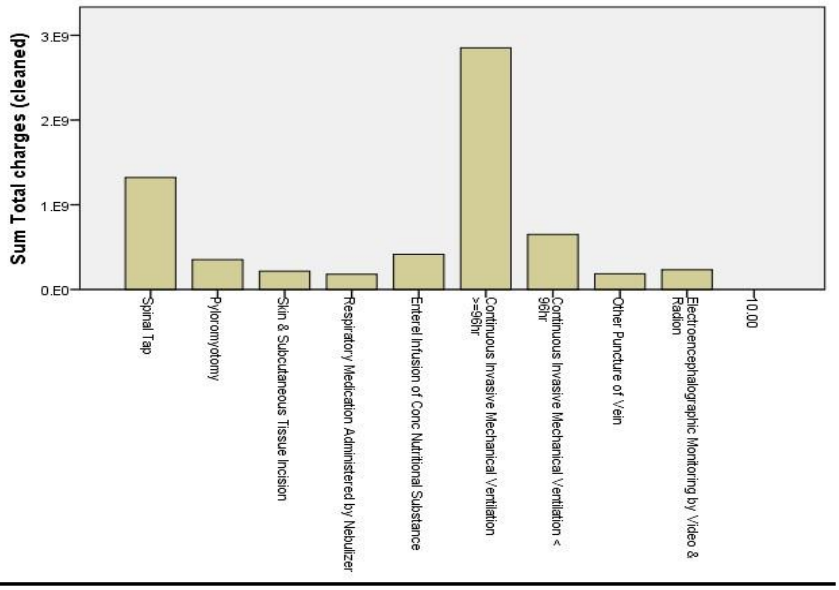


Chart 36 Sum Total Charges for Procedures During Hospitalization

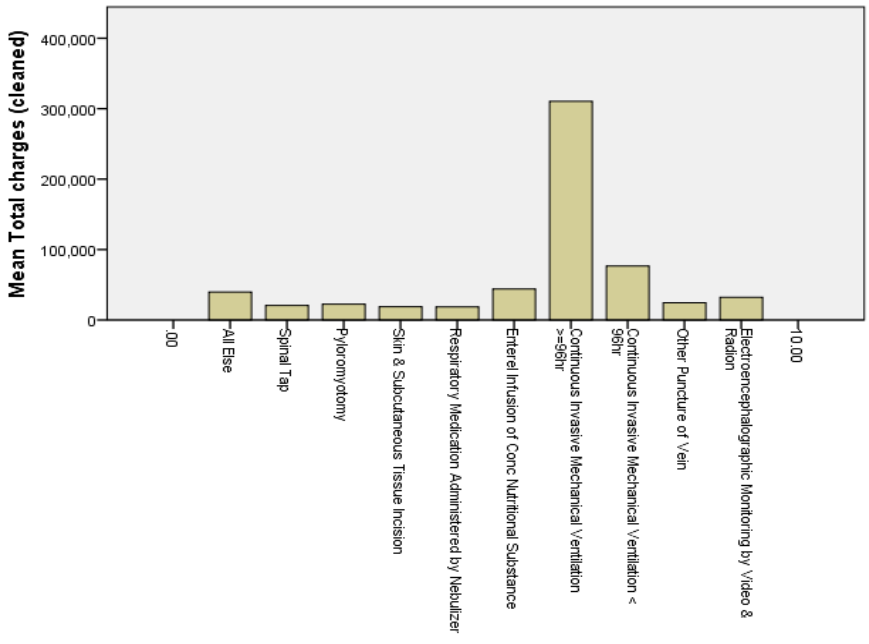


Chart 37 Mean Total charges for Procedures During Hospitalization

4.12 Maternal Diagnoses and Procedures

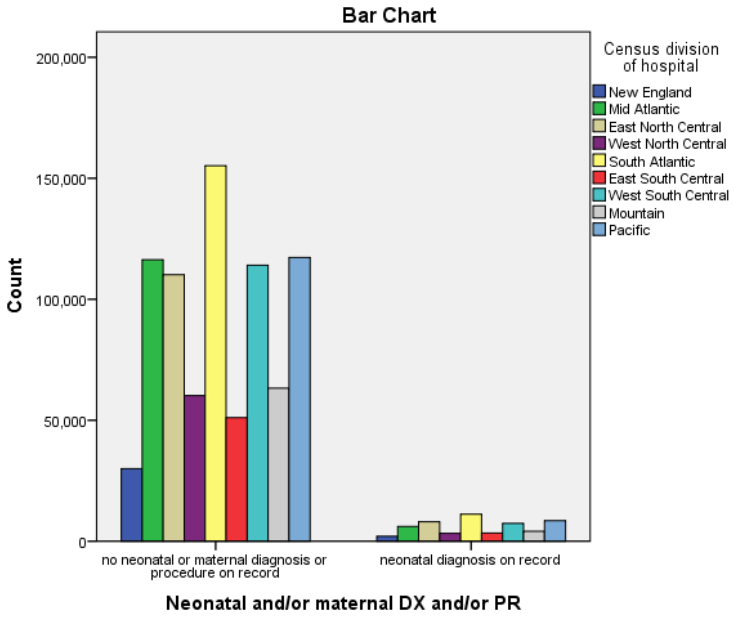


Chart 38 Neo-Natal and Maternal Diagnosis & Procedures by Census Divisions

Maternal records were not linked with these inpatients as this dataset was filtered from Neonates, only inpatients 28-364 days old were included for analysis.

4.13 Source of Origin for Hospitalization

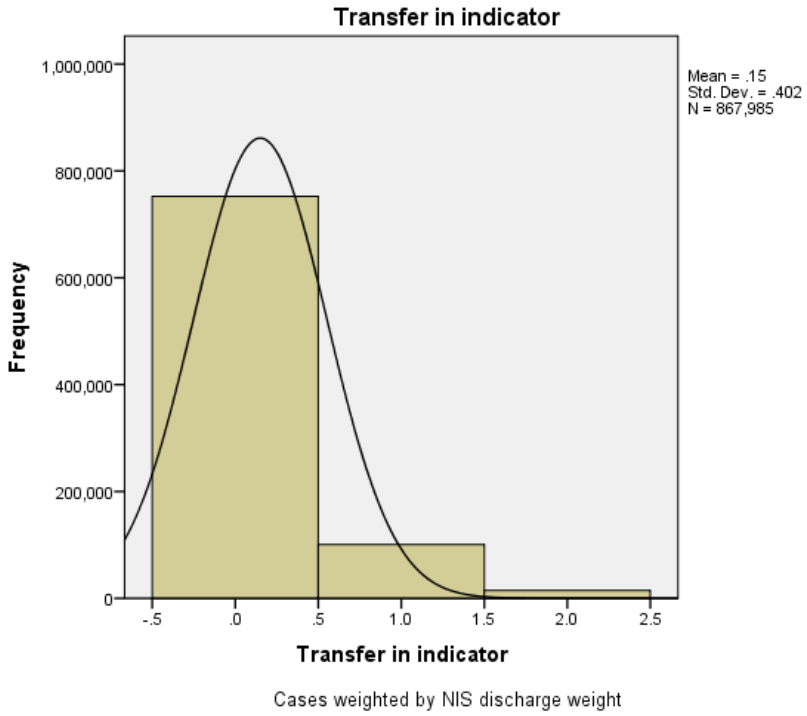


Chart 39 Infants Transferred-In from Acute Care or Other Facilities

Table 16 Source of Origin

Transfer in indicator

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Transfered in or Newborn Admission	752525	86.3	86.7	86.7
	Transfered from a Different Acute Care Hospital	100700	11.6	11.6	98.3
	Transfered from an Other Type of Health Facility	14760	1.7	1.7	100.0
	Total	867985	99.6	100.0	
Missing	System	3860	.4		
Total		871845	100.0		

Most infants were not transferred in or born during these admissions. A minor 11% were transferred in from acute care facilities and 1.7% from other types of health facilities.

4.14 Hospitalization due to Environmental Exposure

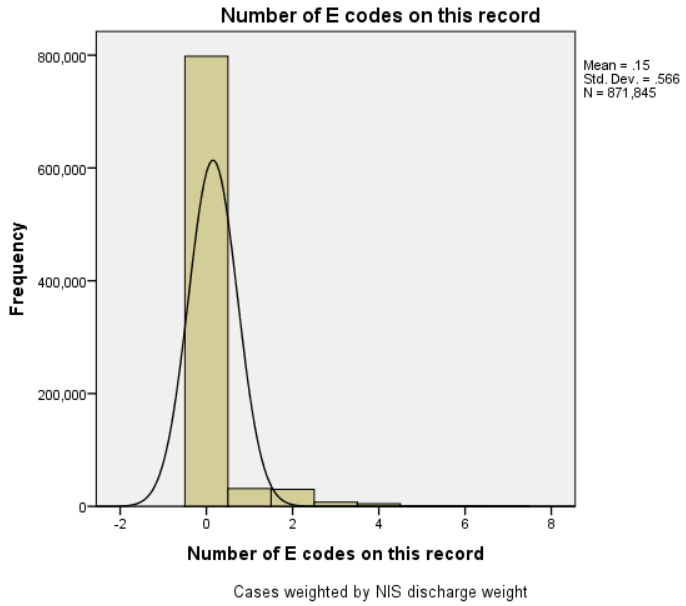


Chart 40 The Number of External Cause of Injuries on Record

The highest was 19.1% of infants with an E code for external injuries from the South Atlantic census region. New England had the lowest external injuries on record at 3.7%.

Table 17 Environmental Exposure to External Cause of Injuries by Census Divisions

		Frequency	Percent
Valid	New England	32110	3.7
	Middle Atlantic	122450	14.0
	East North Central	118250	13.6
	West North Central	63485	7.3
	South Atlantic	166395	19.1
	East South Central	54485	6.2
	West South Central	121520	13.9
	Mountain	67350	7.7
	Pacific	125800	14.4
	Total	871845	100.0

4.15 Hospitalization by Patient Urbanization

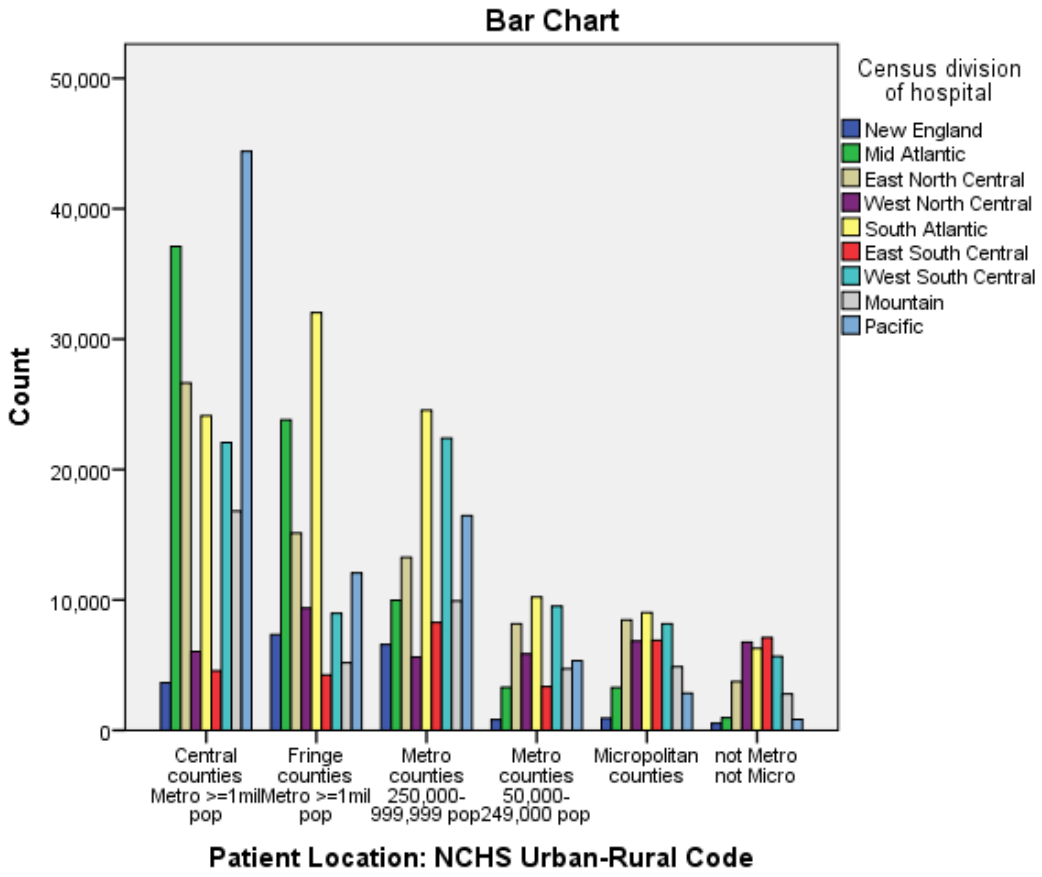


Chart 41 Patient Urbanization

Hospitalization was highest in large metropolitan areas and lowest in micropolitan counties.

Table 18 Urban & Rural Distribution of Infant Residence Type by Census Divisions

Report

Total charges (cleaned)

copymostfreqDx	Patient Location: NCHS Urban-Rural Code	Mean	N	Std. Deviation	% of Total N	% of Total Sum	Sum
RSV	Central Counties of Metro >=1Mill Pop	25598.43	21220	47533.779	10.3%	13.9%	543198485
	Fringe Counties of Metro >=1Mill Pop	23078.45	14705	40163.816	7.2%	8.7%	339368701
	Counties of 250,000-999,999 Pop	19581.33	15270	32280.057	7.4%	7.6%	299006681
	Counties of 50,000-249,999 Pop	15674.76	7050	28992.751	3.4%	2.8%	110507044
	Micropolitan	20959.09	7580	165974.171	3.7%	4.1%	158869553
	Not Metro Not Micro	13074.54	5505	28565.553	2.7%	1.8%	71975265
	Total	21350.44	71330	65695.772	34.8%	38.9%	1522925729
Non RSV	Central Counties of Metro >=1Mill Pop	24661.68	18600	99193.830	9.1%	11.7%	458707084
	Fringe Counties of Metro >=1Mill Pop	21063.57	10390	40797.174	5.1%	5.6%	218850486
	Counties of 250,000-999,999 Pop	18149.49	10070	53680.829	4.9%	4.7%	182765309
	Counties of 50,000-249,999 Pop	15472.50	3790	28544.347	1.8%	1.5%	58640735
	Micropolitan	17965.85	4030	137888.830	2.0%	1.8%	72402086
	Not Metro Not Micro	10934.39	2820	19885.292	1.4%	0.8%	30834877
	Total	20567.43	49700	79089.801	24.2%	26.1%	1022200577
Pnemonia	Central Counties of Metro >=1Mill Pop	24534.07	5885	70642.633	2.9%	3.7%	144382977
	Fringe Counties of Metro >=1Mill Pop	19120.53	4065	36127.527	2.0%	2.0%	77724981
	Counties of 250,000-999,999 Pop	18267.35	4795	21657.189	2.3%	2.2%	87591957
	Counties of 50,000-249,999 Pop	14179.33	3185	16176.363	1.6%	1.2%	45161139
	Micropolitan	11559.11	3390	19479.724	1.7%	1.0%	39185273
	Not Metro Not Micro	10047.33	2430	19338.935	1.2%	0.6%	24415022
	Total	17619.43	23750	41315.047	11.6%	10.7%	418461349
Fever unspecified	Central Counties of Metro >=1Mill Pop	15042.83	5185	20770.949	2.5%	2.0%	77997027
	Fringe Counties of Metro >=1Mill Pop	12866.11	3420	9813.759	1.7%	1.1%	44002101
	Counties of 250,000-999,999 Pop	10990.56	3485	9340.357	1.7%	1.0%	38302078
	Counties of 50,000-249,999 Pop	10218.17	1475	11906.024	0.7%	0.4%	15071786
	Micropolitan	8913.73	1330	6499.028	0.6%	0.3%	11855238
	Not Metro Not Micro	8767.88	795	12933.605	0.4%	0.2%	6970461
	Total	12377.24	15690	14602.090	7.6%	5.0%	194198692
UTI	Central Counties of Metro >=1Mill Pop	18311.61	5995	19156.313	2.9%	2.8%	109778097
	Fringe Counties of Metro >=1Mill Pop	16536.15	3390	18042.883	1.7%	1.4%	56057548
	Counties of 250,000-999,999 Pop	14011.40	3585	11114.174	1.7%	1.3%	50230884
	Counties of 50,000-249,999 Pop	12570.75	1530	15019.945	0.7%	0.5%	19233241
	Micropolitan	9536.29	1225	7686.495	0.6%	0.3%	11681947
	Not Metro Not Micro	9410.44	685	8396.055	0.3%	0.2%	6446142
	Total	15443.50	16410	16285.711	8.0%	6.5%	253427860
Esophageal	Central Counties of Metro >=1Mill Pop	24979.43	4540	53155.800	2.2%	2.9%	113406539
	Fringe Counties of Metro >=1Mill Pop	25321.73	3545	55319.231	1.7%	2.3%	89765516
	Counties of 250,000-999,999 Pop	22760.21	2905	37098.988	1.4%	1.7%	66118342
	Counties of 50,000-249,999 Pop	22754.67	1140	29840.695	0.6%	0.7%	25940312
	Micropolitan	19230.60	1350	34410.460	0.7%	0.7%	25961257
	Not Metro Not Micro	13767.87	855	17357.838	0.4%	0.3%	11771518
	Total	23227.33	14335	46252.572	7.0%	8.5%	332963484
Dehydration	Central Counties of Metro >=1Mill Pop	15924.83	4160	25954.818	2.0%	1.7%	66247315
	Fringe Counties of Metro >=1Mill Pop	14850.17	2705	27882.936	1.3%	1.0%	40169728
	Counties of 250,000-999,999 Pop	11543.00	3215	26457.358	1.6%	0.9%	37110731
	Counties of 50,000-249,999 Pop	8181.43	1625	6625.166	0.8%	0.3%	13294813
	Micropolitan	8490.79	1440	22129.817	0.7%	0.3%	12226691
	Not Metro Not Micro	6876.95	810	5929.156	0.4%	0.1%	5570346
	Total	12513.05	13955	24098.962	6.8%	4.5%	174619625
Total	Central Counties of Metro >=1Mill Pop	23080.25	65585	65487.843	32.0%	38.6%	1513717525
	Fringe Counties of Metro >=1Mill Pop	20510.16	42220	38081.404	20.6%	22.1%	865939061
	Counties of 250,000-999,999 Pop	17567.83	43325	35508.794	21.1%	19.4%	761125983
	Counties of 50,000-249,999 Pop	14541.51	19795	24285.204	9.6%	7.3%	287849070
	Micropolitan	16327.50	20345	119307.671	9.9%	8.5%	332182045
	Not Metro Not Micro	11365.74	13900	22491.721	6.8%	4.0%	157983631
	Total	19100.26	205170	58744.899	100.0%	100.0%	3918797315

4.16 Hospitalization by Race

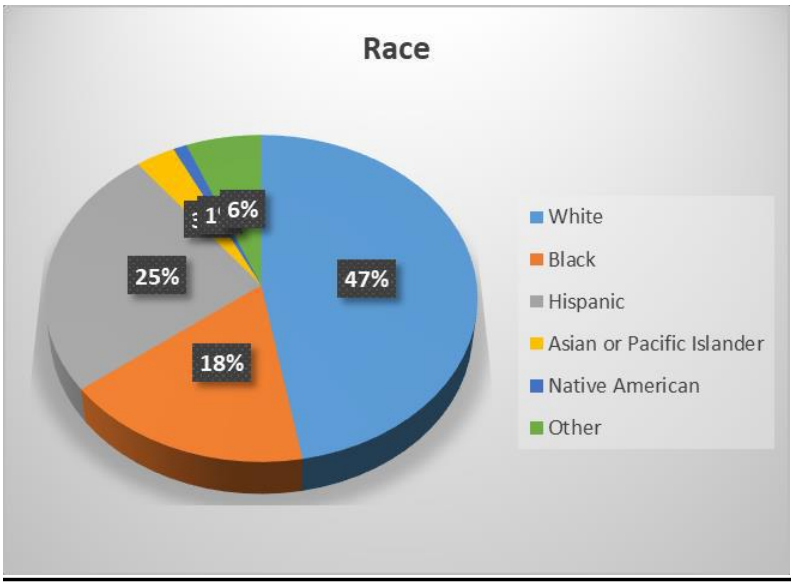


Chart 42. Race

Almost half (47%) the admissions were Caucasian ethnicities which reflects the general population census, a 25% were Hispanic, and 18% Black which is higher than the general population.

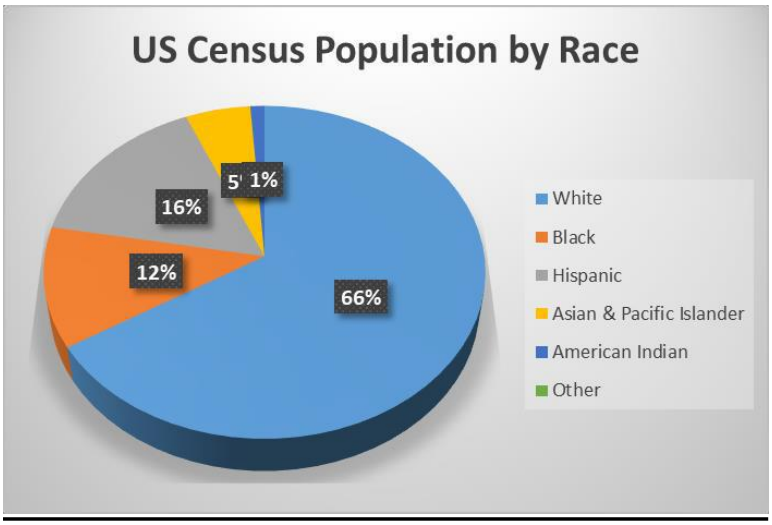


Chart 43. Population Census by Race

https://www.census.gov/quickfacts/fact/table/US/PST045217

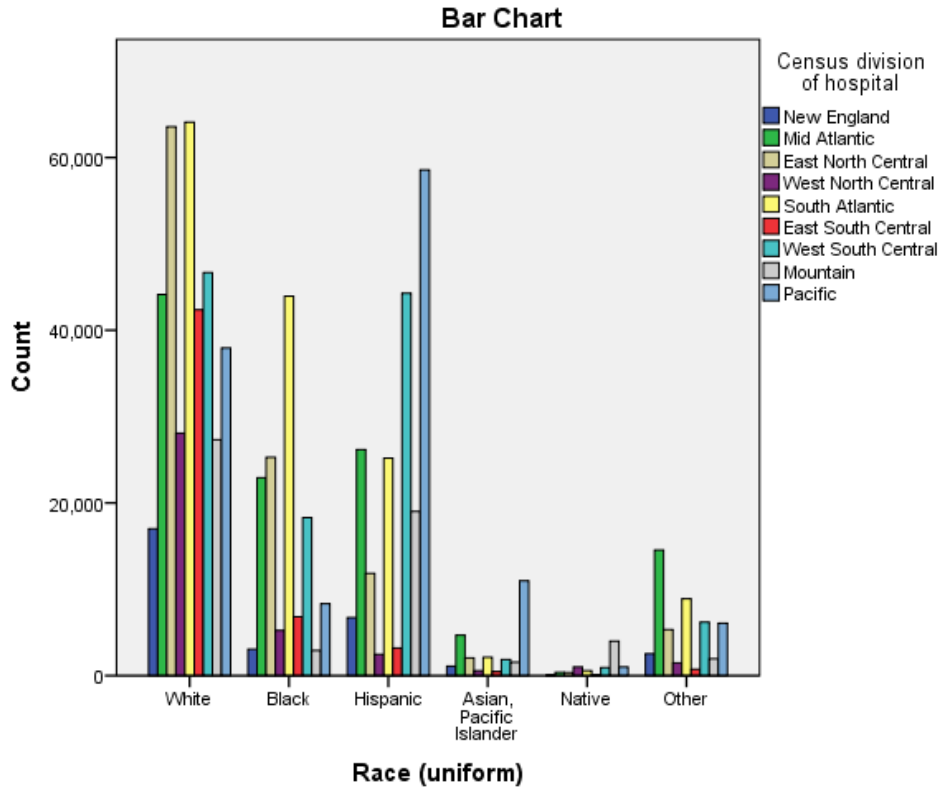


Chart 44. Hospitalization in Census Divisions by Race

The mean charge for white infants was $15342.50 which is 39.8% of the total cost of hospitalization**.** The highest mean charge was $31432.13 for Natives although they represent only 2.1% of cases.

Table 19 Mean and Sum Total Charges of Hospitalization by Race

Race	Mean	%N	Sum	%Sum
White	15342.50	46.6	2158768163	39.8
Black	17482.00	16.5	873051082	16.1
Hispanic	21235.10	27.3	1748073625	32.2
Asian, Pacific Islander	22896.29	2.8	192786650	3.6
Native	31432.13	1.2	116455996	2.1
Other	19742.09	5.6	332654214	6.1
Total	17956.52	100	5421789731	100

4.17 Hospitalization by Insurance Type

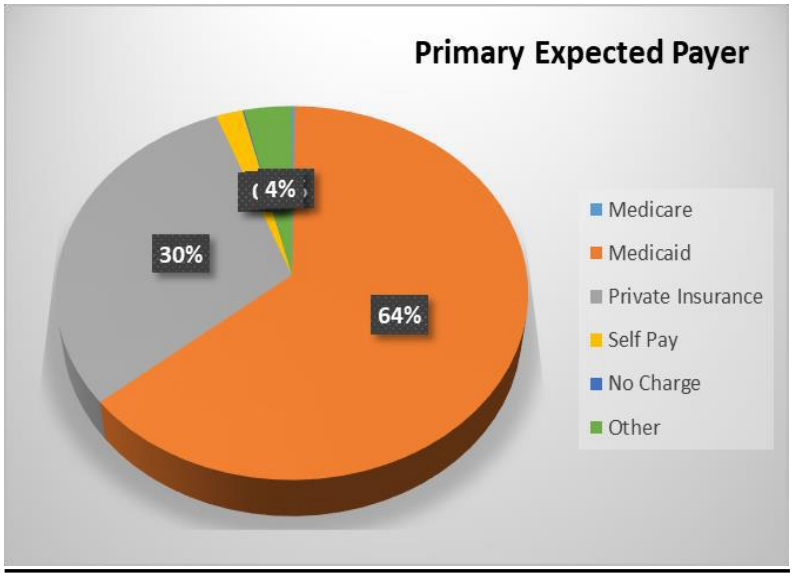


Chart 45 Primary Payer

The majority of patients were Medicaid recipients or low income families utilizing care for these hospital visits compared to a third of the patients who had private insurance and a minority self-pay group.

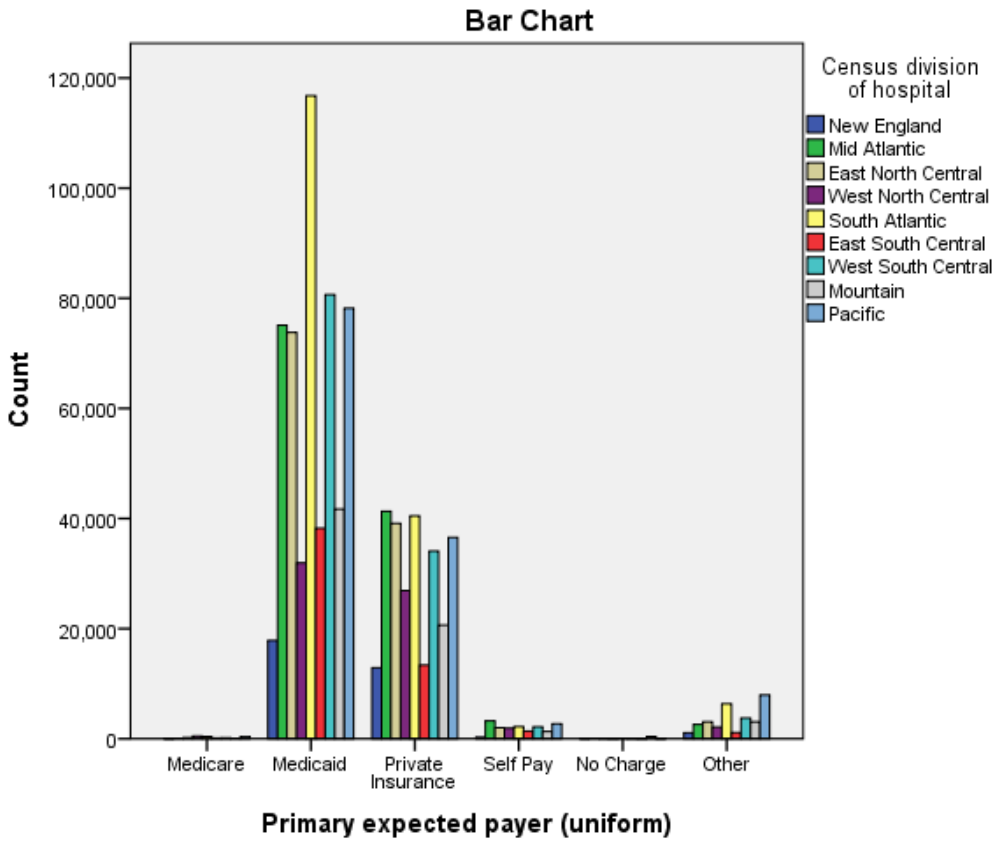


Chart 46. Hospitalization by Type of Insurance in Census Divisions

Table 20 Mean and Sum Total Charges by Insurance Type and Census Divisions

Insurance	Mean	%N	Sum	%Sum
Medicare	24899.26	0.2	14815073	0.3
Medicaid	18031.01	65.8	3915432504	66.5
Private	17020.71	29.0	1627434520	27.6
Self-Pay	17790.34	2.1	120796272	2.1
No Charge	11760.96	0.1	37635884	0.1
Other	21390.78	2.9	207918478	3.5
Total	17838.71	100	5890160431	100

4.18 Hospitalization by Median Household Income

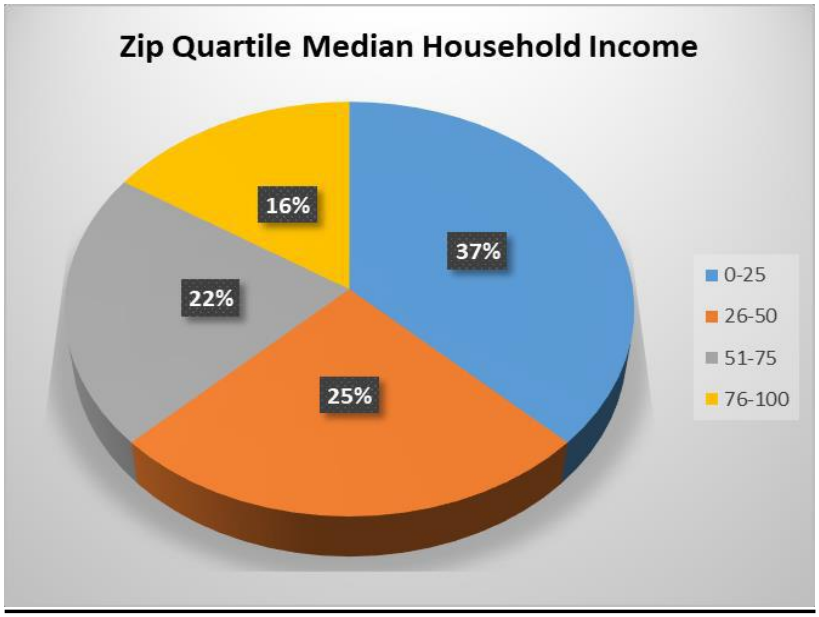


Chart 47. Income

37% of the patients were on a lowest income bracket of 0-25000, 25% earned 26-50000 and 22% earned 51-75K. The New England region is highest in the highest income bracket of 71000+ and the Pacific region is highest in the 54-70999 bracket.

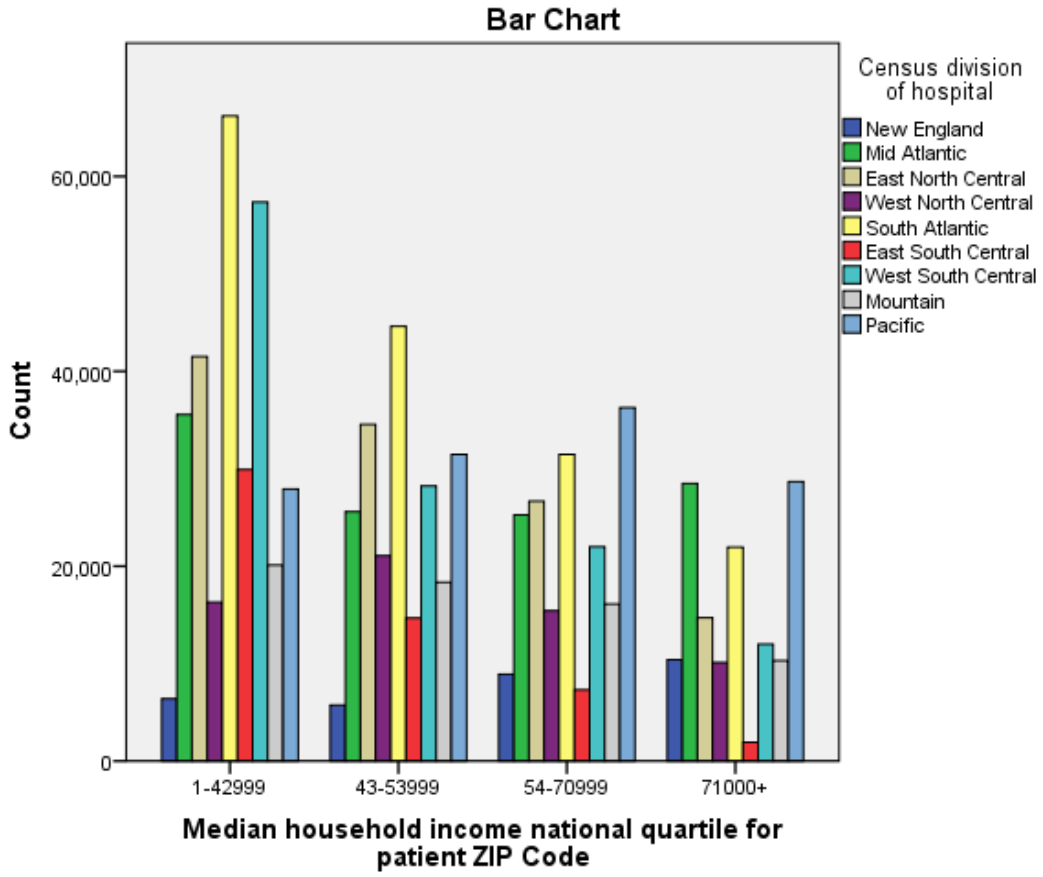


Chart 78. Hospitalization in Census Divisions by Median Household Income

4.19 Hospitalization by Hospital Type

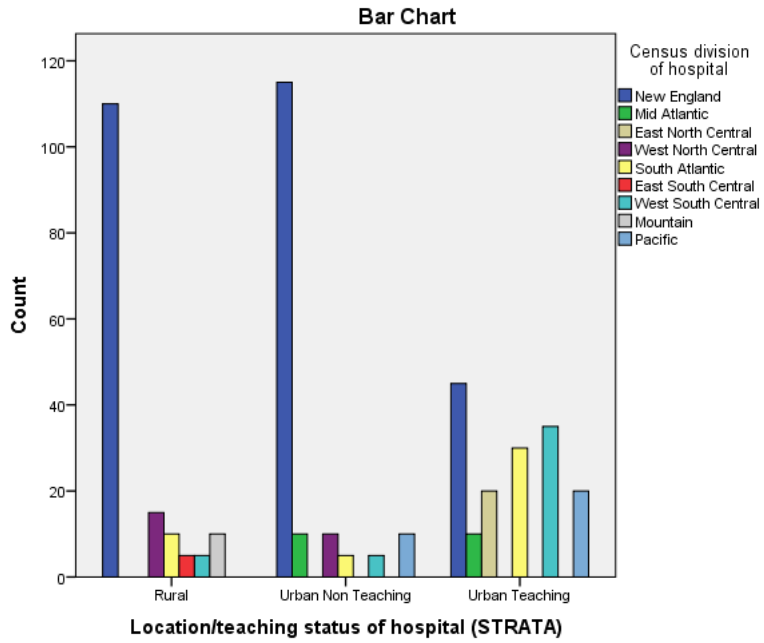


Chart 49. Hospitalization by Hospital Type (Teaching) in Rural and Urban Settings

The New England region has the highest volume of hospitalization in all categories by far. Mean total charges were $20,355.64 in urban teaching hospitals, $12,794.61 in urban non-teaching, and $7,663.55 in rural hospitals.

Table 21 Mean Total Charges by Hospital Type/Urbanization

Report

Total charges (cleaned)

Location/teaching status of hospital (STRATA)	Mean	N	% of Total N	Sum	% of Total Sum
Rural	7663.55	155	33.0%	1187835	18.5%
Urban Non Teaching	12794.61	155	33.0%	1983139	30.9%
Urban Teaching	20355.64	160	34.0%	3256886	50.7%
Total	13676.44	470	100.0%	6427860	100.0%

4.20 Hospitalization by Hospital Ownership

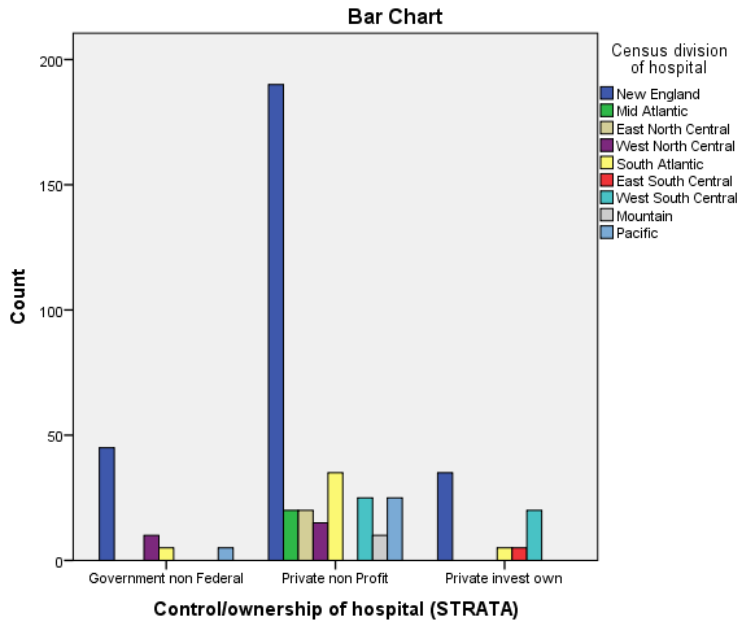


Chart 50. Hospitalization by Ownership of Hospitals in Census Divisions

The New England region has a very high volume of private not for profit hospitalizations. Hospitals for profit pay property and income tax and have to answer to stakeholders. 72.3% of hospitalization was in private, non profit hospitals with a mean total charge of $14,550.07 compared to only $8,225.26 in government non-federal owned hospitals.

Table 22 Hospitalization by Control or Ownership of Hospitals

Report

Total charges (cleaned)

Control/ownership of hospital (STRATA)	Mean	N	% of Total N	Sum	% of Total Sum
Government Non Federal	8225.26	65	13.8%	534636	8.3%
Private non Profit	14550.07	340	72.3%	4946972	77.0%
Private Invest-Own	14557.82	65	13.8%	946252	14.7%
Total	13676.44	470	100.0%	6427860	100.0%

4.21 Hospitalization by Hospital Bed Size

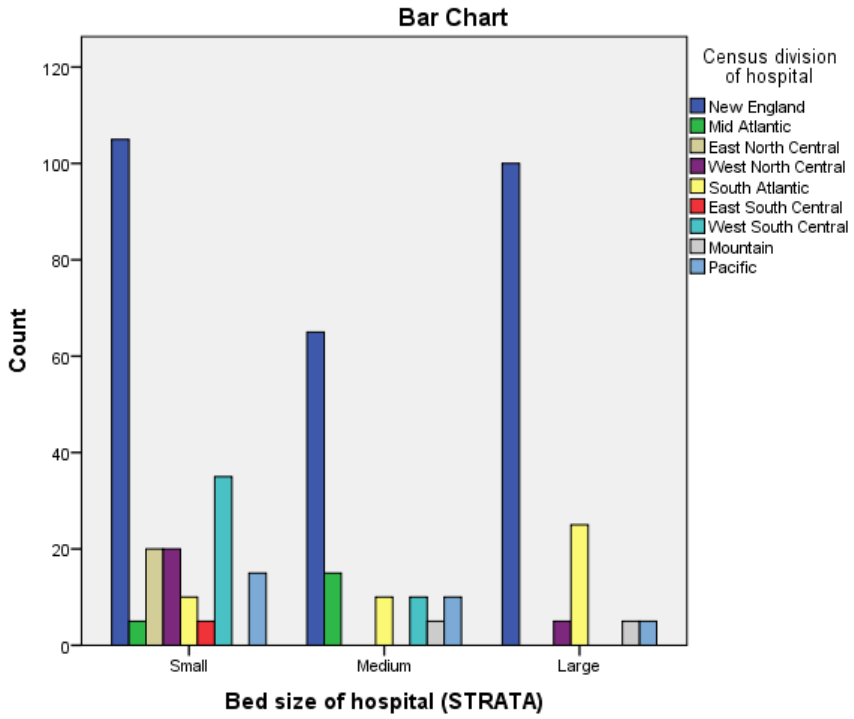


Chart 51. Hospitalization by Hospital Bed Size in Census Divisions

The New England region shows very high hospitalizations in small, medium, and large bed-size hospitals. Small hospitals constituted 45.7% of cases with a mean total charge of $19.503.26 versus $7.942.13 in large hospitals.

Table 23 Mean Total Charges by Hospital Bed Size

Report

Total charges (cleaned)

Bed size of hospital (STRATA)	Mean	N	% of Total N	Sum	% of Total Sum
Small	19503.26	215	45.7%	4193160	65.2%
Medium	9763.70	115	24.5%	1122816	17.5%
Large	7942.13	140	29.8%	1111885	17.3%
Total	13676.44	470	100.0%	6427860	100.0%

4.22 Total Charges for Hospitalization by Type of Insurance

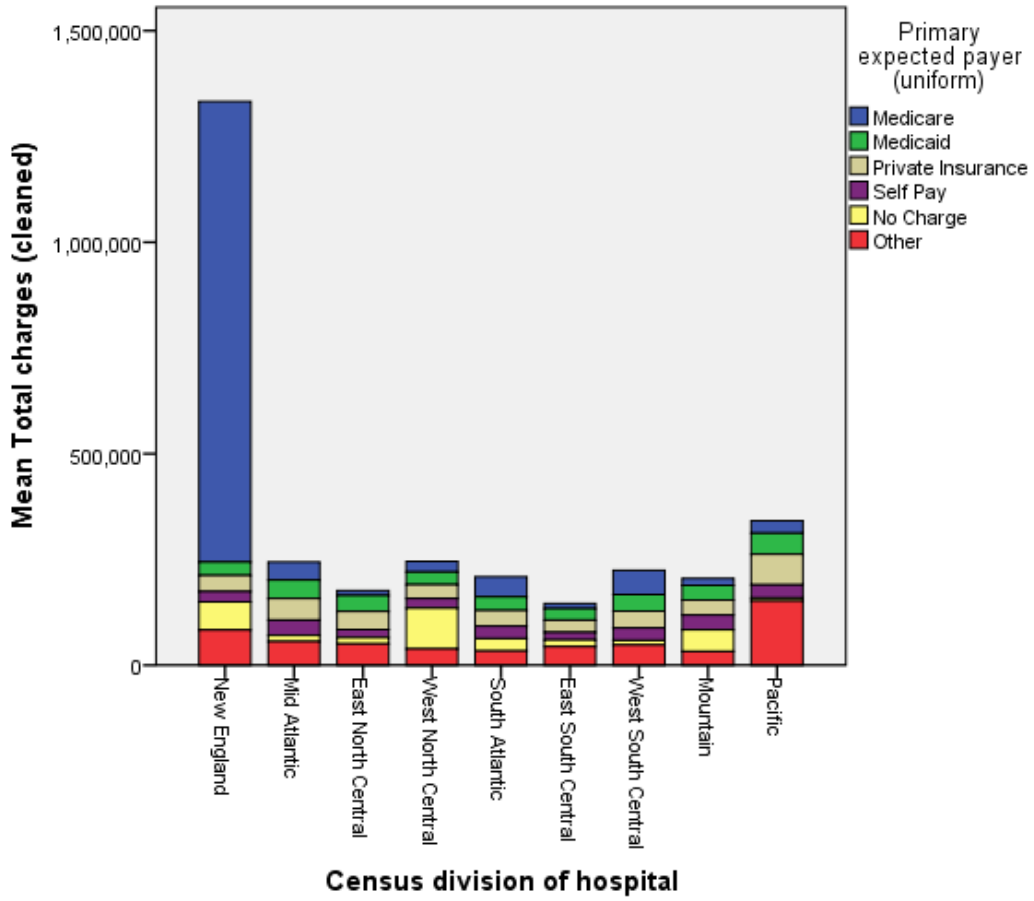


Chart 52. Total Charges of Hospitalization in Census Divisions by Type of Health Insurance

The New England region has a very large volume of Medicare type insurance patients.

4.23 Hospital Discharge

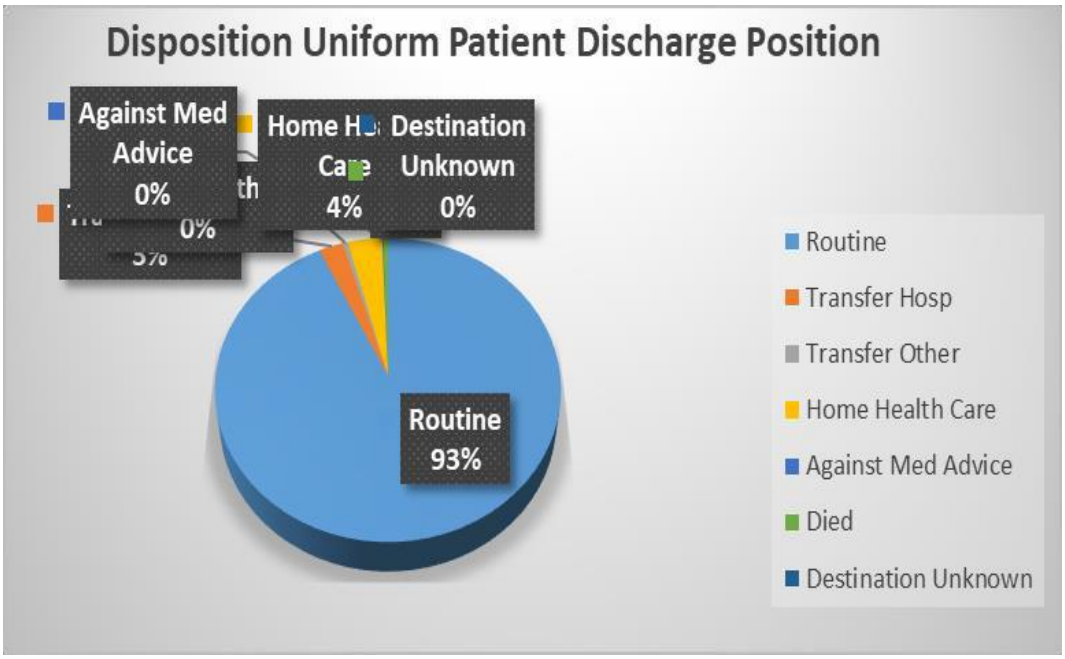


Chart 53. Discharge Position

The majority of patients (92.8%) were discharged as routine visits with a mean total charge of $32,995.95. The rest were transferred to other short-term hospitals, skilled nursing or skilled care facilities, home health care, discharged against medical advice, unknown destination or died.

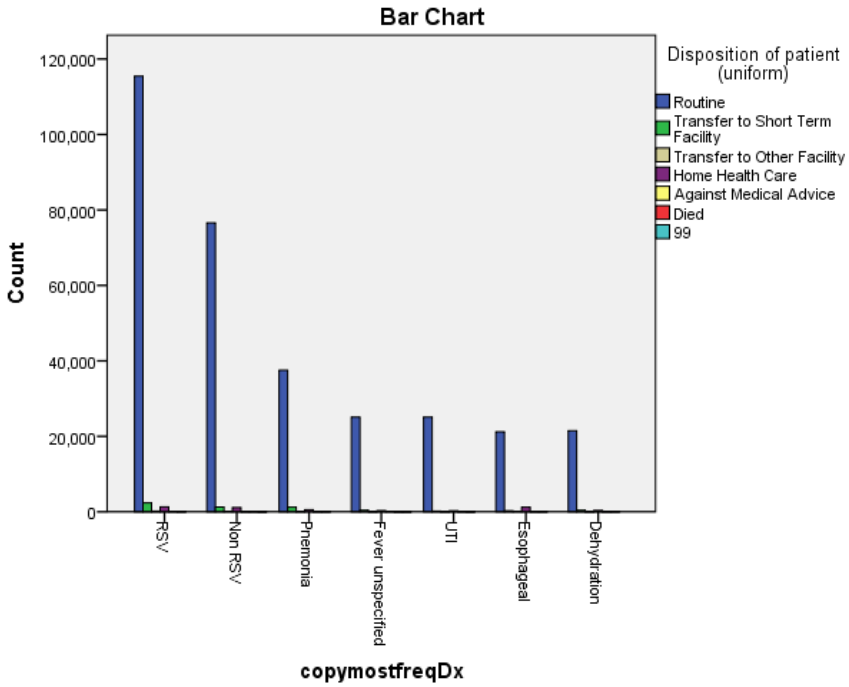


Chart 54. Discharge Frequency by Census Divisions

Table 24 Multivariate Regression for Length of Stay

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.046[a]	.002	-.009	1.356	.002	.183	1	87	.670	
2	.107[b]	.011	-.011	1.358	.009	.827	1	86	.366	
3	.863[c]	.744	.736	.694	.733	246.671	1	85	.000	
4	.882[d]	.779	.768	.650	.034	13.091	1	84	.001	
5	.923[e]	.852	.831	.555	.073	5.500	7	77	.000	[f]

a. Predictors: (Constant), Most frequesnt primary Dx cases

b. Predictors: (Constant), Most frequesnt primary Dx cases , Census division of hospital

c. Predictors: (Constant), Most frequesnt primary Dx cases , Census division of hospital, Race (uniform)

d. Predictors: (Constant), Most frequesnt primary Dx cases , Census division of hospital, Race (uniform), Primary expected payer (uniform)

e. Predictors: (Constant), Most frequesnt primary Dx cases , Census division of hospital, Race (uniform), Primary expected payer (uniform), Control/ownership of hospital (STRATA), Median household income national quartile for patient ZIP Code, Bed size of hospital (STRATA), All Patient Refined DRG: Severity of Illness Subclass, Location/teaching status of hospital (STRATA), Transfer out indicator, Patient Location: NCHS Urban-Rural Code

f. Not computed because fractional case weights have been found for the variable specified on the WEIGHT command.

g. Dependent Variable: Length of stay (cleaned)

The R squared shows the proportion of the length of stay (LOS) that is explained by the multiple independent variables by 18 to 85% changes in the length of stay. In other words, 78-

85% of the variance in length of stay is explained by the independent variables, that is, there is a strong influence of independent variables on the LOS.

The coefficient d and f in the regression shows statistical significance and shows an additive effect on other variables like the frequency of diagnosis, the census divisions, etc. it provides a better estimation, an interaction of the response variables to the length of stay.

Table 25 Coefficients for Length of Stay

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2.440	.306		7.987	.000	1.833	3.047
	Most frequesnt primary Dx cases	.010	.024	.046	.428	.670	-.038	.059
2	(Constant)	2.162	.432		5.004	.000	1.303	3.021
	Most frequesnt primary Dx cases	.007	.025	.030	.273	.785	-.042	.056
	Census division of hospital	.062	.068	.098	.910	.366	-.073	.196
3	(Constant)	1.161	.230		5.047	.000	.704	1.618
	Most frequesnt primary Dx cases	.031	.013	.134	2.406	.018	.005	.056
	Census division of hospital	-.095	.036	-.152	-2.647	.010	-.167	-.024
	Race (uniform)	.929	.059	.893	15.706	.000	.811	1.047
4	(Constant)	1.737	.268		6.485	.000	1.205	2.270
	Most frequesnt primary Dx cases	.020	.012	.087	1.622	.108	-.005	.044
	Census division of hospital	-.025	.039	-.039	-.630	.531	-.102	.053
	Race (uniform)	.912	.056	.877	16.401	.000	.801	1.022
	Primary expected payer (uniform)	-.305	.084	-.216	-3.618	.001	-.472	-.137
5	(Constant)	.930	1.094		.849	.398	-1.249	3.108
	Most frequesnt primary Dx cases	.047	.024	.205	1.987	.050	.000	.094
	Census division of hospital	-.024	.046	-.038	-.509	.612	-.116	.069
	Race (uniform)	1.390	.160	1.337	8.697	.000	1.072	1.708
	Primary expected payer (uniform)	-.262	.081	-.186	-3.232	.002	-.424	-.101
	Transfer out indicator	-.879	.503	-.206	-1.746	.085	-1.880	.123
	Median household income national quartile for patient ZIP Code	.090	.128	.056	.702	.485	-.165	.345
	All Patient Refined DRG: Severity of Illness Subclass	-.653	.161	-.330	-4.065	.000	-.973	-.333
	Bed size of hospital (STRATA)	-.075	.136	-.048	-.554	.581	-.346	.196
	Location/teaching status of hospital (STRATA)	.000	.154	.000	-.003	.998	-.307	.306
	Control/ownership of hospital (STRATA)	-.173	.155	-.073	-1.118	.267	-.481	.135
	Patient Location: NCHS Urban-Rural Code	.248	.114	.309	2.165	.033	.020	.476

a. Dependent Variable: Length of stay (cleaned)

The coefficient summary breaks down the effect to show that even though there is no significance between some of the variables and length of stay there is an additive effect that is masking the relationship between the variables. T shows that the coefficient is significantly different from zero, the constant is statistically significant with all other variables.

Table 26 Multivariate Regression for Total Charges

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.357[a]	.127	.122	27055.507	.127	25.927	1	177	.000
2	.359[b]	.129	.119	27107.141	.002	.323	1	176	.571
3	.907[c]	.822	.807	12675.919	.694	53.703	12	164	.000

a. Predictors: (Constant), Census division of hospital

b. Predictors: (Constant), Census division of hospital, Primary expected payer (uniform)

c. Predictors: (Constant), Census division of hospital, Primary expected payer (uniform), Transfer out indicator, Transfer in indicator, All Patient Refined DRG: Risk of Mortality Subclass, Number of procedures on this record, Race (uniform), Number of E codes on this record, Location/teaching status of hospital (STRATA), Disposition of patient (uniform), All Patient Refined DRG: Severity of Illness Subclass, Number of diagnoses on this record, Patient Location: NCHS Urban-Rural Code, Number of chronic conditions

d. Dependent Variable: Total charges (cleaned)

Independent variables show strong influence and explain 82% changes in the total charges. There is statistical significance of the independent variables on the total charges.

Table 27 Coefficients for Total Charges

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-3020.982	5389.070		-.561	.576	-13655.670	7613.707
	Census division of hospital	4535.090	890.651	.357	5.092	.000	2777.497	6292.683
2	(Constant)	-4744.953	6194.170		-.766	.445	-16968.882	7478.976
	Census division of hospital	4250.428	1023.487	.334	4.153	.000	2230.620	6270.235
	Primary expected payer (uniform)	1207.724	2126.564	.046	.568	.571	-2988.958	5404.407
3	(Constant)	22046.029	11634.552		1.895	.060	-925.761	45017.818
	Census division of hospital	713.421	568.099	.056	1.256	.211	-408.259	1835.101
	Primary expected payer (uniform)	2146.911	1252.599	.081	1.714	.088	-326.278	4620.101
	Disposition of patient (uniform)	-7903.482	1983.685	-.234	-3.984	.000	-11820.160	-3986.804
	Number of chronic conditions	2680.758	2949.627	.109	.909	.365	-3143.121	8504.637
	Number of diagnoses on this record	957.179	1075.661	.077	.890	.375	-1166.656	3081.013
	Number of E codes on this record	26500.426	3739.201	.334	7.087	.000	19117.576	33883.276
	Number of procedures on this record	18567.860	963.203	.757	19.277	.000	16666.068	20469.653
	Race (uniform)	4543.637	989.383	.252	4.592	.000	2590.153	6497.120
	Transfer in indicator	-11166.020	9581.364	-.064	-1.165	.246	-30083.902	7751.863
	Transfer out indicator	7534.779	3869.178	.072	1.947	.053	-104.703	15174.262
	Location/teaching status of hospital (STRATA)	-1077.007	2312.968	-.031	-.466	.642	-5643.837	3489.824
	All Patient Refined DRG: Risk of Mortality Subclass	-23190.882	4704.302	-.316	-4.930	.000	-32479.270	-13902.494
	All Patient Refined DRG: Severity of Illness Subclass	-461.138	2209.547	-.013	-.209	.835	-4823.769	3901.494
	Patient Location: NCHS Urban-Rural Code	-128.893	1198.508	-.008	-.108	.914	-2495.281	2237.495

a. Dependent Variable: Total charges (cleaned)

CHAPTER V

DISCUSSION

5.1Outcome and Discussion of the Study

5.1.a Optimum Utilization of Healthcare Resources and Services

The majority of post-neo-natal hospitalization according to HCUP in 2012, 2013, 2014 were discharged as routine visits (93% and mean total charge of $32,995.99). When admitted, 45% did not have records that meet any emergency department criteria, so they could not be admitted through the Emergency Department (ED). Only 37% had an emergency department revenue code on record, 10% had a positive emergency department charge when revenue center codes are not available, so they were admitted under ED because there was no other code to be used. While 8% had an ED CPT procedure code, so 37%+8%=45% had billable ED record on admission. Most of these infants were not at risk of mortality with 75% minor likelihood of dying, so they may have been admitted for an acute episode but not at risk of dying. Their severity of illness was 45% minor loss of function and 35% moderate loss of function, so there was no major debilitation. 98% of these patients did not present with comorbidity of substance abuse, there were no drugs or alcohol in their system. 53% did not show chronic conditions, and only 26% with one condition, 22% were discharged with 2 diagnoses on record, and 19% have 2-3 diagnosis upon discharge. The patients were not chronically predisposed, which may

be useful in patient risk stratification. The majority of patients were not operated on with 58% discharged with no procedure on record and 24% required one procedure during hospitalization, mainly spinal tap with mean total charge $20,591.84.

These results show that infants 28-364 days old in 2012, 2013, 2014 showed utilization of hospitals for care that was classified as routine for the most part. They did not have chronic morbidities, nor severity of illness, were with low risk of dying, minor loss of function, were not under major substances of concern, did not require procedures, and were not even eligible for emergency room billing.

According to the American Academy of Pediatrics the Clinical Practice Guideline for RSV involves but is not limited to; supplemental oxygen, nasogastric or intravenous fluids for patients who cannot maintain oral hydration, nebulized hypertonic saline, avoidance of exposure to tobacco, bronchodilator medications to open the airways, antiviral medications for severe cases or high-risk infants, good handwashing techniques and contact isolation to decrease exposure. Prophylactic monoclonal antibodies (palivizumab, virazole) to reduce the impact and economic burden for immunocompromised infants. Breastfeeding is encouraged for at least 6 months to decrease the morbidity of respiratory infections.[65]

Utilizing secondary care facilities and resources for what otherwise can be done at primary care settings is expensive and duplicative effort that could be redirected to recycle spending, improve efficiency and ultimately improve health outcomes throughout the health system.

5.1.b Burden of Socioeconomics

These discharge episodes billed as "Routine" may also include readmissions which have been shown to cost Medicaid and private insurance $7.6 and $8.1 billion respectively according to AHRQ [55]

These healthcare transactions consume the majority of expenditure in total charges as shown by the Emergency Department service indicator. The total charges accrued were paid for by Medicaid as primary payer 64% of the time or a sum total charge of $22,225,844,224, and private insurance 30% of the time or a sum total charge of $10,418,364,416. Therefore, these patients were utilizing hospitals for healthcare that may not have required hospitalization and these costs may have been avoidable. Over a third (37% and a mean total charge $36,762.98) of inpatients came from the lowest household median income in the country (0-25000 zip quartile income percentile) and a quarter (25%) were of the next level (25-60000 zip quartile income). Both Medicaid as well as private insurance patients may have been reporting to hospitals for care that could have otherwise been addressed in ambulatory settings.

72% of hospitalization was in privately owned, non-profit hospitals, 45% were small bed size hospitals, while 34% hospitalization was in urban teaching hospitals, 33% in urban non-teaching, and 33% in rural hospitals. Urban teaching hospitals charged more than twice as much as rural hospitals at $20,355.64 and $7,663.55 respectively. Small hospitals charged more than twice as large ones at $19,503.26 and $7,942.13 respectively, and privately owned hospitals charged almost twice as much as government owned institutions at $14,550.07 and $8,225.26 respectively.

The mean total charge by primary diagnosis for LOS with RSV was $19,645.90, non RSV $18,623.13, pneumonia $16,652.26, and esophageal reflux at $23,371.26.

5.1.c Regional Discrepancies

Hospitalization for infants varied between population census divisions by total charges, length of stay, frequency of primary diagnosis, race, primary insurance payer and other factors. Patient location or urbanization and hospital type also played a part in patient flow through secondary healthcare settings and consequently throughout the various census divisions. As did patient income levels, chronic conditions, procedures done during hospitalization, severity of illness, and whether the patient was at risk of mortality.

A notable discrepancy is that states varied in their insurance structure and in their reporting methods and there is not a joint framework of continuously standardized data to allow large scale and long term analysis. The State Children's Health Insurance Program (SCHIP) may be classified as Medicaid, Private Insurance, or Other depending on each state. Most states do not identify patients in SCHIP specifically, so it is not possible to present this information separately. This may explain the outlier volume for Medicare in the New England census region.

According to the Dartmouth Atlas of Healthcare research, census divisions and the regional capacity of health systems, including doctors per capita, and beds per capita, determine the amount or intensity of care a patient may receive including the frequency of hospitalization, the frequency of doctor visits, the number of procedures, and LOS in intensive care units.[67]

On the other hand, the Institute of Medicine, found that regional differences in price markups are the prime influencers on geographic variation in spending, rather than the utilization of health services.[68] The IOM also found significant price variations related to the margin above the cost of inputs that a payor or provider chooses to set or negotiate.[69]

Meanwhile, the Patient Centered Outcome Research Institute (PCORI), suggests that the continuous growth in the cost of health care is partially driven by the lack of focus on measurements of outcome. This creates the need to integrate clinical research and health

economics studies to increase evidence based care.[70]

5.1.d Primary Diagnoses, Confounding Measures, and Diagnostic Uncertainty

The most frequent diagnoses which are mainly respiratory in nature overlap in symptoms and are challenging for patients who utilize hospitals as their usual source of care. More patients were hospitalized in the winter months of December, January, February, and March than the rest of the year. This was especially higher for Acute Bronchiolitis RSV, non RSV, and Pneumonia. Respiratory Syncytial Virus is the leading primary diagnosis for these infants, followed by Acute Bronchiolitis due to other organisms non RSV, Pneumonia due to unspecified organism, Urinary Tract Infections, Unspecified Fever, Esophageal Reflux, and Dehydration.

Discomfort with risk and diagnostic uncertainty where the probability of a diagnosis is unknown, or information is missing leads to personal risk aversion by both the patient and provider and results in further testing.[71] This behavior increases cost in fear of mal practice liability and is sometimes referred to as ambiguity bias. Differences in provider practice patterns sometimes create individual or institutional variation in spending,[75,76] especially when coupled with inappropriate resource utilization of preference sensitive treatment decisions.[72,77] Hence, clinical decision support systems should be embedded in the system where appropriate and patients should consistently be informed of treatment options and alternatives for shared decision making.

5.1.e Correlations

Analysis of variance showed significant relations and strengths of associations between various aspects of post-neo-natal care in terms of social determinants like race, income, geographic residence, and urbanization with hospitalization aspects such as the likelihood of hospitalization by most frequent primary diagnoses, length of stay, total charges, and disposition or patient outcomes.

Post-neo-natal care is multifaceted and evolving alongside a large population that is continuously diversifying. This is demonstrated by variations in patient health status, treatment preferences, access and availability of primary care.

According to the Kaiser Family Foundation analysis of the National Health Interview Survey of 2017, for non-elderly Americans 18-64 years old; 50% uninsured, 12 % publicly insured, and 11% privately insured had no usual source of care. These numbers include respondents who said their usual source of care was the emergency room. This non-elderly population would have included new mothers who may feel the same way about their usual source of care being the hospital.

Together with my findings, this demonstrates a very heavy burden on the healthcare system to be tackling routine visits at secondary care setting when they ordinarily fall under organized routine postnatal care. It also burdens the health care financial system through Medicaid, which is to say the majority of those routine hospital visits came from socioeconomically disadvantaged populations.

This population may therefore be defined as at high risk of routine hospital visits for post-neo-natal care and as such can be targeted with various strategies for risk stratification and predictive analytics to define the core issues creating this need for hospital visits defined as routine by the hospital and by the billing/coding system. If indeed those patient conditions or episodes are able to be met at primary care ambulatory settings, then those total charges and health care resources could be redirected to areas of more dire need for medical attention and parents can be relieved of preventable stress over their children's health and well-being. Unnecessary hospitalization may also place patients at risk of exposure to hospital acquired conditions (HAC).

5.1.f Impact of Social Determinants of Health (SDoH), Environment, and Health Behaviors in Health Outcomes

According to the World Economic Forum, social risk factors and the environment also have a significant part to play in the well-being of patients. Social determinants account for 20% of health outcomes, healthcare 10%, genomics 30%, and individual behavior 40%. Whether these routine hospital visits were a result of gaps in healthcare, social determinants, or individual behavior, they consume effort needed elsewhere and impact spending and resource consumption in an already strained system.

In order to compile long term patient profiles for health, one must conduct risk stratification and take into account patient outcomes directly related to clinical care, genetics, environmental factors, socioeconomic circumstances, social determinants of health, and individual behavior patterns. Risk scores can be used as metrics to indicate the likelihood of a single event such as a hospital admission for readmission within the next 6 months. A risk stratification framework may combine several individual risk scores to create a broader profile of a patient in their complex ongoing needs. These risk scores may be used to estimate costs, target interventions, gauge a patient's health literacy and lifestyle choices, and used to prevent patients from developing more serious conditions that could result in higher spending and worse outcomes. The use of Artificial intelligence or Machine Learning for health intelligence can be applied here.

The American Academy of Pediatrics (AAP) recommends assessment for developmental problems in every preventive health visit but formal screening is only recommended at intervals of 9^{th}, 18^{th}, 24^{th} or 30^{th} month of the well child visits for children 10-71 months old. According to this study, screening needs to occur on every visit in order to optimize on these patient engagements, improve longitudinal health profiles and build data in real time for predictive analytics.

In general, ethnic minorities consistently receive less preventive care, undergo fewer procedures, and are seen by fewer specialists.[73] These differences cannot be accounted for by insurance status, household income, education, or age, but are bluntly due to bias or racism.[73] Ethnic minorities disproportionately live in areas that have low quality hospitals and providers, which may explain a large portion of the observed disparities in care.[74] However for this age group, in this study, hospitalization by race was almost always proportional to the general population census except for the black population.

5.2 Limitations of the Study

Variation in data collection (including data content and reporting methods) through the years did not allow for a continuous cumulative analysis, thus 2012, 2013, 2014 were used as the most recent data and most alike in content for data elements. As per HIPAA guidelines, the unique identifier used for patients on admission only refers to that patient per visit, so once the patient is discharged the event is a transaction with a very unique identifier. If the same patient returns or is readmitted to the same hospital or a different hospital in the same state or outside the state, a new unique identifier is issued. The patient cannot be followed for consecutive admissions to assess reasons for hospital visits at this point until the readmission's dataset is obtained. The lack of data on primary care limits extrapolations of results from primary care.

Some data elements such as readmissions, maternal education, and age by month were discontinued or absent and as such could not be utilized in this analysis. There was also a lack of data on environmental exposures like air and water quality, housing data, smoking data, and genomic data.

CHAPTER VI

SUMMARY AND CONCLUSIONS

6.1 Conclusions, Further Research and Recommendations

More than a fifth of post-neo-natal infants between 2012-2014 or 22.05% of infants less than one-year-old were hospitalized for a mean of 4.7 days with a mean total charge of $40,516.48 and a sum total charge of $34,727,880,784. Over 45% of these infants were not eligible for emergency room billing and 92.7% or $32,192,745,472 were discharged on routine disposition. The majority of these patients or 64% costing $22,225,844,224 were of the lowest median household income paid for by Medicaid and over half with a minor loss of function and minor likelihood of dying. The diagnoses were primarily respiratory with the majority of patients not requiring any procedure during their stay at hospital.

There needs to be a continuous real time root cause analysis of hospitalization set up in order to optimize and personalize transition of care post discharge. There needs to be an improved care process for patient engagement and education to avoid readmissions and divert traffic from hospitals and eliminate the no usual source of care approach. Diffusion of health care to patients allows them to take ownership of their health with a personalized healthcare plan. It creates a competitive edge in the industry as healthcare consumerism reforms supply and demand to a more progressive capitalist market, by increasing buying power for patients in order to

increase patient retention and reduce patient loss to follow up.

Therefore, the take away is to reduce hospitalizations and emergency visits, while encouraging routine scheduled well visits in ambulatory care settings to improve compliance with healthcare protocols for post-neo-natal infants and postpartum mothers to empower them to take more responsibility for their own health,

A personalized transition of care for long term needs beyond 30 days, written plan of care, needs to accompany new mothers back to their homes, with a communication to their usual source of care providers. Patient providers at community settings need to be involved continuously in this process to ensure patients are not lost to follow up. There needs to be optimal coordination of care between providers specific to the patient, such as their pediatrician, obstetrician and gynecologist, dermatologist etc. in a unified patient portal platform where providers can communicate simultaneously with each other and the patient on patient care plans. The plan needs to allow patients informed, unbiased, shared decision making with accurate perception of risk and consistent with patients' values[66], their understanding of how to take medications or use medical devices if any. New mothers need to understand their responsibility in managing their health and that of their babies and be aware of resources available, where to find them and where to seek further help. They need to be appointed social service workers if required and be aware of community resources available. The system needs to accommodate continuous transitions to allow interactive consumer care and keep up with the keen consumer awareness and internet of things.

Meanwhile digital health tools can be utilized in targeted outreach programs to engage patients and allow continuum of care for a more responsive and preventive landscape inclusive of environmental factors, social determinants, and positive long term effects on individual behavior and health literacy.

6.2 Integration of Demographics, Patient Centered Medical Outcomes, and Health Service Delivery into a Learning Health System to Improve Health Outcomes

Whether these routine hospital visits were a result of gaps in healthcare, social determinants, or individual behavior, they consume effort needed elsewhere and impact spending and resource consumption in our healthcare system. The categories recognized by the Institute of Medicine (IOM) as contributors to health care waste are; unnecessary services that add to expenses without improving health, inefficient care due to systems errors and failures of coordination, prices that are excessively high, excessive administrative costs, fraud, and missed prevention opportunities. If this routine discharge is classified as waste healthcare expenditure, it diverts major resources from other important domestic priorities like infrastructure, education, research, and other public goods. According to the IOM, in order to improve medical outcomes, service delivery outcomes, and cost outcomes, an evolving clinical process model or Learning Health System must be established and link post-neo-natal care with postpartum care to address IMR and MMR in the US.

In order to compile long term patient profiles for health, one must conduct risk stratification and take into account patient outcomes directly related to clinical care, genetics, environmental factors, socioeconomic circumstances, social determinants of health, and individual behavior patterns, including linking maternal postpartum care and infant postnatal care synergistically with real time infographics. In order to improve patient outcomes and move from fee-for-service to value-based care, and shift from reactive to preventive landscape, a more comprehensive and patient centered coordinated care is needed to optimize maternal and post-neo-natal care simultaneously with focus on population health management.

There needs to be an integration of clinical data with environmental, community, and social

health determinants in order to allow machine learning and natural language processing to extract meaningful use from unstructured data in EHR and provide real time predictive analytics (using the screening tools from AAP for every well visit).

Iterative identification and stratification of patients at risk of hospitalization can reduce routine visit traffic and address the core reasons for major admissions. A triage system upon admissions would further stratify patients as to whether or not hospitalization is actually necessary and if appropriate redirect patients back to primary care.

There needs to be targeted outreach, integrated cultural competency, performance measures to track disparity patterns, and support and collaboration in research. Home nurse visiting programs have been shown to reduce post-neo-natal mortality rates[52] and should be encouraged. Engaging care givers can also absorb some of the burden from hospitals and reduce cost of paying professionals to provide home health care.

Currently adoption of digital health by providers is at 90-95% nationally, especially for patient portals, but actual utilization of patient portals by patients is about 15%. Therefore, efforts may be redirected toward optimal utilization of health informatics including visual effects for patients to encourage higher adoption and utilization of digital health by patients for a more sustainable health development strategy.

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