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EXAMINING THE ROLE OF HOSPITAL SETTING AND NURSE STAFFING ON LENGTH OF STAY AMONG PATIENTS WITH CHRONIC HEART FAILURE

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ABSTRACT

With increased awareness about the implications of quality failures and the direct role nurses play in the delivery of care, research examining the impact of nurse staffing on outcomes, such as length of stay (LOS), has increased significantly over the past decade. While quality can be measured in a variety of ways, LOS is one important indicator of hospital efficiency that is often associated with quality of care. The purpose of this study is to provide a comprehensive analysis of the role of nurse staffing on length of stay for patients with congestive heart failure in rural, urban teaching, and urban non-teaching hospital settings. This study used data from the AHRQ's Healthcare Cost and Utilization Project 2011 National Inpatient Sample. The sampling framework for this study was limited to discharges containing a diagnosis of chronic heart failure (N=81,791). Using Stata Version 13, a negative binomial regression was conducted to primarily examine the association of LOS with nurse staffing/skill mix while controlling for covariates such as hospital location/teaching status, admission type, bed size, and patient-level demographics. Patients discharged with chronic heart failure had an average LOS of 6.9 days, which did not significantly vary by nurse staffing quartiles but did significantly vary by hospital location from 5.5 days (rural hospitals) to 7.0 days (urban teaching hospitals), unadjusted for covariates ($p<0.0001$). Findings were similar in fully-adjusted models. There were no differences in LOS by nurse quartiles, however the LOS was significantly lower among rural and urban non-teaching hospitals relative to urban teaching hospitals (0.75 and 0.95 times the incidence, respectively). Comparing patient outcomes, quality of care, and nurse staffing levels in different hospital settings can give insight to the best and most efficient practices and help hospitals ensure they are providing the best quality of care to patients with chronic heart failure.

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INTRODUCTION

Health care reform in the United States over the past few decades has been focused on the triple aim: improving quality, improving population health, and decreasing the costs of health care (Institute for Healthcare Improvement, 2012). Quality of care first became a major concern within in the United States when the Institute of Medicine published a report in 1999 estimating that as many as 98,000 hospital deaths could be attributed to medical errors (Institute of Medicine, 1999). Delivering quality care is not only essential for a patient’s well-being, but also to health systems and payers, as quality deficits have significant financial implications. Specifically, quality deficits, including adverse events and medical errors, are associated with longer lengths of stay and more intense treatment, which result in increased costs for both hospitals and third party payers (Andel, Davidow, Hollander, & Moreno, 2012). With the shift to value-based reimbursement introduced by the Affordable Care Act, focusing on delivering quality care is even more essential, as value-based purchasing evaluates and pays health care providers according to specific performance measures for quality and efficiency (McKesson Health Solutions, 2014).

While quality can be measured in a variety of ways, length of stay (LOS) is one important indicator of hospital efficiency that is often associated with quality of care. Research points to the assumption that failures in quality of care often increase the risk of complication, which may in turn be associated with longer than expected LOSs (Thomas, Guire, & Horvat, 1997). Under the prospective payment system, hospitals are reimbursed a flat fee per patient based on the patient's diagnosis, meaning longer LOSs do not necessarily result in higher reimbursement (Chassin, 1983). Long LOSs can result in significant inpatient costs for hospitals, which is why variations in LOS have been such a prevalent research topic over the past decade. Along with reducing longer than expected LOSs, health care researchers are stressing the importance of containing readmissions in order to improve care coordination and achieve cost savings. Longer LOSs for some diseases, particularly congestive heart failure (CHF), have been found to be associated with risk of hospital readmission and mortality within 30 days (Reynolds et al., 2015).

Congestive heart failure had the largest amount of 30 day readmissions in 2011 of all adult readmissions, totaling 134,500 readmission and $1.7 billion in total costs (Hines, Barret, Jiang, & Steiner, 2012). The annual number of hospitalizations for people with CHF has increased dramatically over the past 25 years, now totaling over 1 million per year (Kim & Han, 2013). Reducing readmissions, especially among heart failure patients, has become even more important with Medicare's Hospital Readmission Reduction Program, which penalizes hospitals with high rates of Medicare readmissions (Boccuti & Casillas, 2015). Medicare beneficiaries have the largest amount of total readmissions (55.9 percent) and associated costs for readmissions (58.2 percent) (Hines et al., 2012). The American College of Cardiology Foundation, American Heart Association, and Physician Consortium for Performance Improvement developed performance measures in collaboration with CMS, the Joint Commission, and the National Quality Form to evaluate hospital performance and link value based payments for treatment of CHF to quality and efficiency (American Heart Association, 2013). Length of stay is one of the many reporting measures that is used to analyze hospital performance (American Heart Association, 2013). The expected or "appropriate" length of stay for patients with CHF varies based on hospital and patient characteristics; the average LOS for patients with a CHF diagnosis is between 4.9 and 5.9 days (Centers for Disease Control and Prevention, 2014; Chen, Dharmarajan, Wang, & Krumholz, 2013). Although research indicates the average length of stay for CHF patients has declined over the past decade, readmission rates have increased (Chen et al., 2013; Winslow, 2010). In response to the growing prevalence of this disease, determining the appropriate LOS while also reducing preventable hospital readmissions have become even more prominent among health policy discussions (Kim & Han, 2013).

BACKGROUND

Many of these indicators used to measure quality of care and hospital efficiency, such as LOS and readmission rate, have been found to be particularly sensitive to care delivered by nurses (Savitz, Jones, & Bernard, 2005). With increased awareness about the implications of quality failures, the importance of containing readmission rates, and the direct role nurses play in the delivery of care, research examining the impact of nurse staffing on quality outcomes has increased significantly over the past decade (Aiken et al., 2011; Blegen, Goode, Spetz, Vaughn, & Park, 2011; Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Martsolf et al., 2014). A large number of studies indicate that nurse-staffing patterns are related to both patient outcomes and length of stay (Aiken et al., 2011; Blegen, Vaughn, & Vojir, 2007; Kutney-Lee & Aiken, 2008; Martsolf et al., 2014; Needleman et al., 2011; Pronovost, Dang, Dorman, & Lipsett, 2001). Additionally, studies indicate increases in the nursing staff, as well as the skill mix of nurses, is associated with improved quality and reduced length of stay (Aiken et al., 2011; Martsolf et al., 2014). While a number of studies have examined the relationship between nurse staffing and patient outcomes, relatively few studies have focused on the role geography plays in this relationship.

Length of stay figures are known to vary widely based on geographic area (Chassin, 1983). For the past two decades, researchers have been studying the implications of these geographic differences and questioning whether they are associated with patient health outcomes (Chassin, 1983). Studies that have examined the difference between length of stay in rural versus non-rural hospitals for pediatric patients found that large urban hospitals exhibited a longer length of stay than hospitals in other geographic categories (Lorch, Zhang, Rosenbaum, Evan-

Shoshan, & Silber, 2004). While large urban hospitals typically treated patients that were on public insurance and had higher co-morbidities, they also tended to have more technology and other resources to treat patients (Lorch et al., 2004). With more technology and resources, additional test and procedures may be ordered, which increases the amount of time patients spend in the hospital. When measuring 30 and 60 day mortality rates, studies found that teaching hospitals provide better overall quality of care than other hospital types; however patients at teaching hospitals were likely to have longer LOS (Yuan, Cooper, Einstadter, Cebul, & Rimm, 2000). Again these differences in LOS have been attributed to the amount of educational and research activities that are customary at teaching hospitals (Yuan et al., 2000). A more recent study that examined quality of care and patient outcomes at rural critical access hospitals found that many disparities still exist between care provided in rural areas versus urban areas (Joynt KE, Harris Y, Orav E, & Jha AK, 2011). A significant portion of the critical access hospitals in rural settings not only had fewer clinical and technological resources, but also provided care inconsistent with standard quality metrics and often had worse patient outcomes (Joynt KE et al., 2011). A study that examined how hospital factors and staffing ratios impact elderly patients' risk of readmission found that patients being admitted to a hospital with a relatively short average LOS, such as rural hospitals, significantly increase the patient's risk of early readmission (Heggestad, 2002). Contrary to the previous findings, a study that examined the mortality and readmission rates for 3 different conditions, including CHF, found that teaching hospitals were associated with lower mortality rates, but higher readmission rates (Mueller, Lipsitz, & Hicks, 2013). As previously discussed, higher nurse staffing ratios have been found to protect patients from poorer outcomes and longer than expected LOSs; however, as noted above study findings vary when controlling for different hospital settings or particular conditions (Ayanian &

Weissman, 2002; Blegen et al., 2011; Heggestad, 2002; Mueller et al., 2013). This is one the main limitations in the literature that this thesis will address.

Studies have also found that patient-level demographics, such as insurance type, can be predictors of LOS. A longitudinal study based on a nationally representative sample of five years of hospitalizations found that patients without insurance had shorter stays than patients with insurance (Mainous, Diaz, Everett, & Knoll, 2011). As evident in the literature search, a number of studies have examined the differences between hospital setting and patient outcomes; however findings vary by setting and condition. Improvement efforts to increase quality outcomes and determine adequate LOSs must therefore take into consideration that variation between hospitals and the types of patients they treat can and do exist.

When looking at specific disease outcomes, such as heart failure, in rural hospitals, studies have found that appropriate nurse staffing plays an essential role in increasing organizational readiness for quality initiatives and implementation of best practices (Newhouse et al., 2013). A stable nursing staff, with little turn-over, has a positive effect on the quality of care delivered and care processes for heat failure patients (Newhouse et al., 2013). While studies have linked nurse-turnover and appropriate staffing to patient satisfaction and quality of care processes (Blegen et al., 2007; Kane et al., 2007; Newhouse et al., 2013), very few studies have specifically examined the role nurse staffing, hospital location/teaching status, and other hospital characteristics play in hospital length of stay among patients with congestive heart failure within one model.

The purpose of this study is to provide a comprehensive analysis of the role of nurse staffing, rural and urban teaching and non-teaching hospital settings, and other factors on LOS for patients with congestive heart failure. With over five million Americans currently living with

CHF, studying this specific disease has become increasingly important (CDC, 2015). Researching the relationship between nurse staffing, length of stay, hospital location, and other hospital characteristics will give insight into why some hospitals operate more efficiently and effectively than others when treating patients with CHF. Findings will have important implications for improving staffing patterns in hospitals and advancing overall quality of care for patients with CHF, including reducing LOS.

METHODS

Data Source

This study used data from the 2011 National Inpatient Sample (NIS) database, which is maintained by the Agency for Health Research and Quality (AHRQ) as part of the Healthcare Cost and Utilization Project (HCUP). The NIS is the largest publicly available inpatient care database in the U.S., containing data from more than 8 million hospital stays (Agency for Healthcare Research and Quality Healthcare and Utilization Project (HCUP), 2013). The database contains discharge-level records from a sample of hospitals participating in HCUP, which includes information from inpatient stays for 1,049 hospitals and discharges (Agency for Healthcare Research and Quality Healthcare and Utilization Project (HCUP), 2013). The final database was constructed using a one-to-one merge to combine the NIS Inpatient Core Files (which includes data for all discharges) and the Diagnosis and Procedure Groups File (which includes data from the AHRQ software used to analyze ICD-9-CM diagnostic and procedure information). The Hospital Weights File was then many-to-one merged onto the previous combined file to include all hospital characteristics. See the Introduction to the HCUP Nationwide Inpatient Sample 2011 for further description of each file within the NIS and the identifiers used in each file (Agency for Healthcare Research and Quality Healthcare and Utilization Project (HCUP), 2013).

Study Population

The study sample was limited to hospital discharges containing a diagnosis of chronic heart failure (CHF). A discharge was classified as having a CHF diagnosis if it included a principal or secondary diagnosis code matching the ICD-9-CM code for CHF (108). The final dataset linked nurse staffing variables, hospital location variables, and CHF discharge data for 1,049 hospitals with a total discharge sample of N=81,791. These discharges represent the study subpopulation, however, all other observations were retained in the sample so that weighted complex survey design could be applied to appropriately generate standard errors.

Outcome of Interest

Inpatient length of stay (LOS) for CHF diagnoses ranged from 0 to 314 days. Discharges with a LOS greater than 40 days were eliminated as outliers. This analytical decision was based on analysis of the variable. LOS was plotted in a histogram, which can be seen in Figure 1. As visible in Figure 1, the distribution tail becomes invisible before 50 days. After zooming in further on the histogram and running a tab of LOS, I found there were occasional solitaire data points after 40 days; however 99% of the data was contained between 0 and 40 days. Figure 2 shows a histogram of LOS from 0 to 40 days. As visible, the distribution tail nicely tapers down around 40 days. The extreme data points outside of 40 days were eliminated as outliers. The decision to remove these outliers is supported by literature, as it suggests outliers can lead to inflated standard errors and significantly reduce the power of statistical tests (Zimmerman, 1994). Less than 0.06 percent of discharges were eliminated as a result of this exclusion.

Figure 1 Histogram of Original Length of Stay Variable

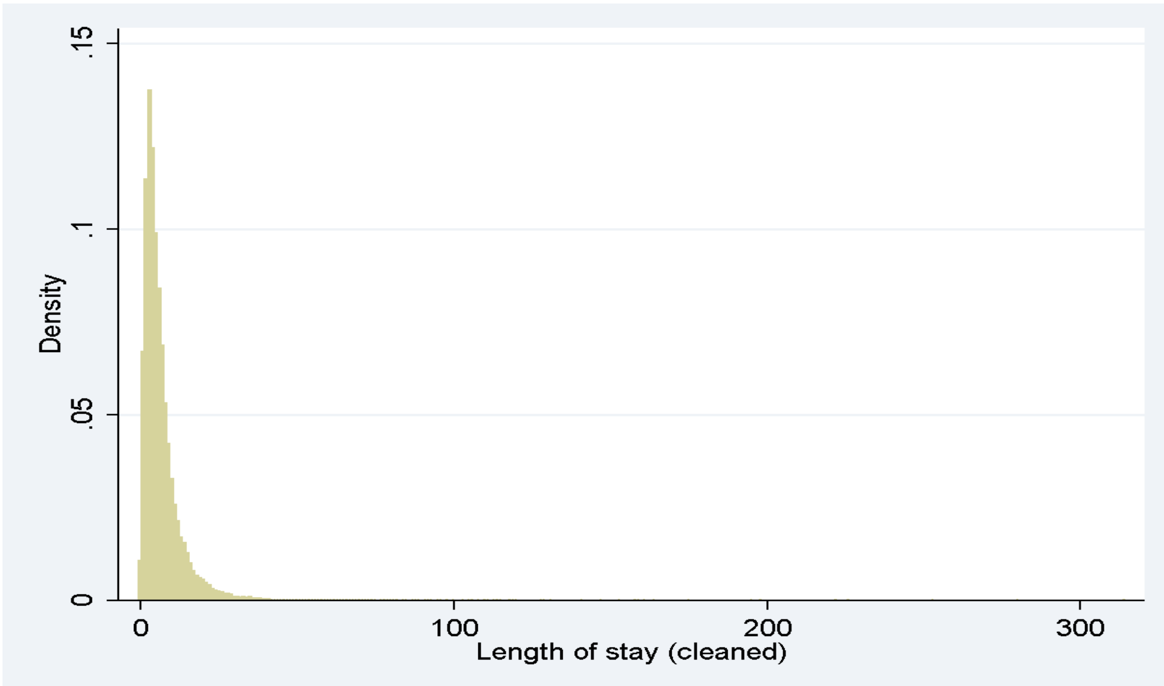
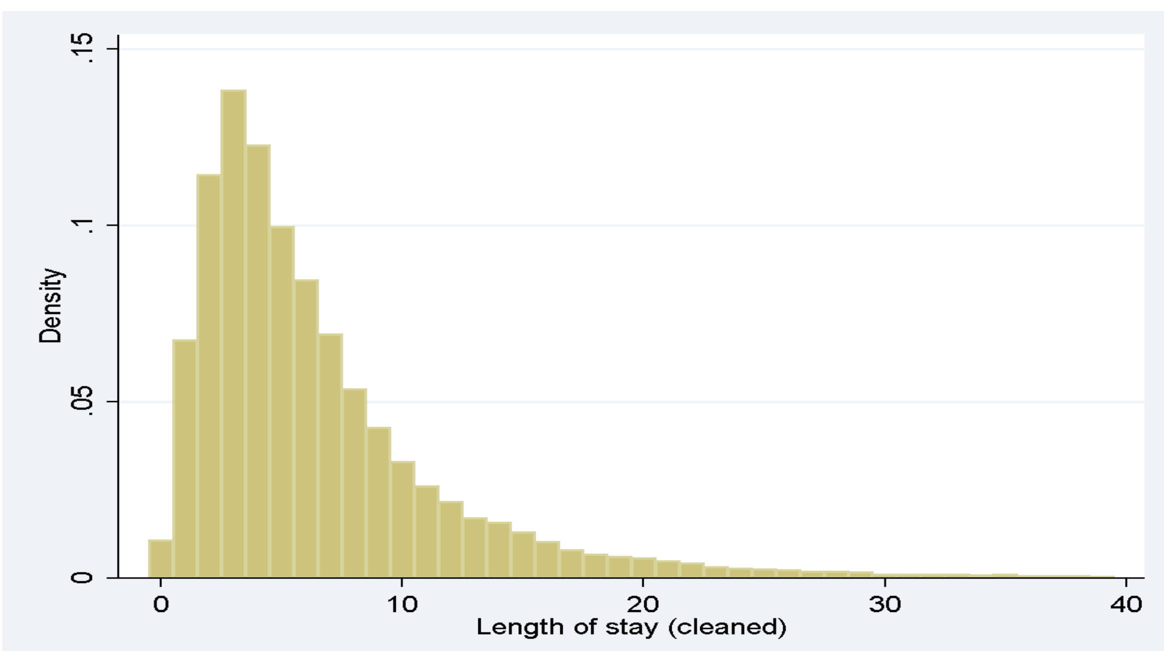


Figure 2 Histogram of Length of Stay Less than 40 days



Main Independent Variables

Nurse staffing and skill mix was defined as one of the main predictors in this study. Nurse staffing was measured by the total number of FTE nursing staff (licensed nurses and nursing aides) per 1000 adjusted inpatient days. The total FTE nurse variable was created by adding the number of FTE Registered Nurses (RNs), the number of FTE licensed practical nurses (LPNs), and the number of FTE nursing aides (NAs). The number of FTE RNs ranged from 0 to 10.9 FTEs, the number of FTE LPNs ranged from 0 to 3.4 FTEs, and the number of FTE NAs ranges from 0 to 3.9 FTEs. The total FTE nurse variable was created into a quartile variable for analysis: I) 4.3 or fewer FTEs, II) 4.4 to 5.4 FTEs, III) 5.5 to 6.6 FTEs, and IV) 6.7 or more FTEs. Nurse skill mix was measured by the total number of FTE licensed nurses (RNs and LPNs) per 1000 adjusted inpatient days. The total number of FTE licensed nurse variable was created by adding the number of FTE RNs and FTE LPNs, and then modified into a quartile variable for analysis: I) 3.5 of fewer FTEs, II) 3.6 to 5.4 FTEs, III) 5.5 to 6.2 FTEs, and IV) 6.3 or more FTEs. The decision to create quartile nurse staffing and skill mix variables is supported by previous studies that used quartile variables to prove a causal relationship between nurse staffing and mortality (Kane et al., 2007). Hospitals with nursing staff per 1000 adjusted inpatient days of <1 were excluded from the study, as assumed to be extreme outliers (Martsolf et al., 2014).

Hospital location was defined as another main predictor of LOS. Hospital location was a categorical variable defined as rural, urban non-teaching, or urban teaching. As previously discussed, hospital teaching status can be another predictor for LOS (Lorch et al., 2004; Yuan et al., 2000). Including a variable to distinguish the difference between teaching and non-teaching helped analyze if statistically significant differences exist because location/teaching status and LOS among patients with CHF.

Control Variables

Control variables likely to be associated with LOS were also included in the study. Patient-level variables included: patient's sex (female as referent), age (continuous), race, the urban-rural classification of patient's location of residence, and the median household income for patient's ZIP code. For the purposes of the bivariate analysis and further analysis of Medicare patients, age was made into a binary variable to compare patients 65 years and younger with patients age 65 and older. Uniform coding for Race included white (referent group), black, Hispanic, Asian or Pacific, Native American, and other. The location of patient's residence was divided into six categories according to the National Center for Health Statistics Urban-Rural Code: "central" counties of metro areas greater than or equal to 1 million population (referent group); "fringe" counties of metro areas greater than or equal to 1 million population; counties in metro areas of 2500,000 to 999,000 population; counties in metro areas of 50,000 to 249,000 population; micropolitan counties; and other. Median household income for the patient's ZIP code was divided into four categories: $1-$38,999 (referent group); $39,000-$47,999; $48,000-62,999; and $63,000 or more.

Variables associated with discharge-level analysis included the admission type (emergency (referent group), urgent, elective, or other) and the primary expected payer (Medicare (referent group), Medicaid, private, or other).

Additional hospital-level variables included bed size, control/ownership, and multi-hospital system membership (non-member or member). Bed size was categorized by HCUP into three categories: small, medium, and large (referent group). Bed size categories assess the number of short-term acute beds in a hospital and were created by HCUP using hospital region, the urban-rural designation of the hospital, and teaching status of the hospital ("HCUP NIS Description of Data Elements. Healthcare Cost and Utilization Project (HCUP)," 2008). Control/ownership of hospital is divided into three categories: government, nonfederal; private, non-profit (voluntary) (ref); and private, investor-owned (proprietary).

ANALYSIS

To account for over-dispersion in the LOS variable, the study used a negative binomial regression model to determine the association between LOS and nurse staffing/skill mix. The negative binomial regression model (NBRM) in other words is used for over-dispersed count data in which the variance of the outcome variable is much larger than the mean (J. Scott Long, 2006). While the NBRM has the same mean structure as a Poisson regression, it includes an extra parameter to model the over-dispersed count variable (J. Scott Long, 2006). The NBRM also corrects downwardly biased standard errors and small p-values that would occur in the Poisson regression when the outcome variable is over-dispersed (J. Scott Long, 2006). The justification of choosing the NBRM over a zero-inflated negative binomial regression model is that the LOS variable did not have excess zeros by distribution.

RESULTS

Table 1 displays the mean LOS and percentages of all CHF discharges for each of the variables described above (N=81,281). These values are weighted to be nationally representative of CHF discharges among all discharges with an ICD-9 –CM code of "diseases of the circulatory system" (HCUP, 2011). The average length of stay for all CHF discharges was 6.9 days. Age for CHF diagnoses ranged from 0 to 110 years, with an average age of 73.3 years. Nearly 75% of patients with a CHF diagnosis were 65 years or older. Gender was 46.9% male and 53.1% female. The average number of FTE RNs per 1000 adjusted inpatient days for CHF discharges was 4.11 and the average number of total FTE nursing staff, including both licensed nurses and nursing aids, was 5.43. At all sampled hospitals, there was a large percentage of RNs among all nurses. The average percentage of RNs among all nurses was 93 percent. Among CHF discharges, the majority (70.4%) of patients were admitted as emergency and primarily paying with Medicare (78.7%). Additionally, a higher percentage of CHF discharges came from urban hospitals, classified as a large bed size, private non-profit hospitals, and a member in a multi-hospital system. There were slightly more CHF discharges at urban teaching hospitals (44.82%) versus urban non-teaching hospital (42.2%).

Table 2 displays weighted bivariate analyses of all study characteristics stratified by LOS, nurse staff variables and hospital location/teaching status. First, several significant bivariate differences were observed by LOS. Urban teaching hospitals had a longer LOS (7.0 days) than both rural (5.5 days) and urban non-teaching hospitals (6.5 days) ($p<0.0001$). Private investor-owned hospitals had a longer average LOS (7.0 days) than both government (6.3 days) and private non-profit hospitals (6.5 days). Longer LOS was also observed in non-emergency admissions, those under 65 years of age, hospitals with small or large bed size, members of multi-hospital system membership, and more dense urban regions. There were also significant differences by race and by primary payer, but with no clear pattern. Second, statistically significant differences occurred between hospital location/teaching status and all covariates ($p<0.05$, though most were $p<0.0001$). Urban teaching hospitals generally had more nurses than both rural and urban non-teaching hospitals. As the table shows, 31.26% of urban teaching hospitals had 6.7 or more FTE nurses, compared to only 8.41% of rural hospitals and 13.26% of urban non-teaching hospitals. Furthermore, 12.59% of urban teaching hospitals had 6.3 or more FTE licensed nurses, compared to only 3.05% of rural hospitals and 6.25% of urban non-teaching hospitals. Lastly, other than discussed above, there were some significant differences looking across the nursing staff/skill columns. Generally, traits significantly more concentrated in hospitals with higher quartiles of nursing staff/skill include larger hospital bed size, non-emergency admission type, private primary payer, younger age patients, male sex, and more urban location of patient residence.

Table 1. Weighted Descriptive Statistics for CHF Discharges: Healthcare Cost and Utilization Project National Inpatient Sample (2011)

Variables	Mean (SD) or %
Total no. Discharges (N)	81,281
Outcome measure	
Length of stay	6.9 (7.37)
Nurse staffing variables	
Number of FTE RNs per 1000 adjusted inpatient days	4.1 (0.07)
Percentage of RNs among all nurses	93.6 (0.26)
Number of Total FTE nursing staff (licensed and nursing aides) per 1000 adjusted inpatient days	5.4 (0.08)
Number of FTE licensed nurses (RN + LPN) per 1000 adjusted inpatient days	4.4 (0.07)
Hospital Location/Teaching Status	
Rural	13.0
Urban Non-Teaching	42.2
Urban Teaching (ref)	44.8
Hospital-level variables	
Bed Size	
Small	13.0
Medium	24.5
Large (ref)	62.4
Ownership/Control	
Government, nonfederal	9.9
Private, non-profit (voluntary) (ref)	75.6
Private, investor owned (proprietary)	14.6
Multi-hospital system membership	
Non-member	26.7
Member	73.4
Discharge-level variables	
Admission Type	
Emergency (ref)	70.4
Urgent	17.3
Elective	12.1
Other	0.2
Primary Payer	
Medicare (ref)	78.7
Medicaid	6.7
Private	11.1
Self-Pay	1.9
No charge	0.2
Other	1.5
Patient-level variables	
Age	73.3 (0.18)
Age (binary)	
Under 65	25.4
65 or older (ref)	74.6
Sex	
Male	46.8
Female (ref)	53.2
Race/ethnicity	
White (ref)	71.0
Black	17.9
Hispanic	6.8
Asian or Pacific Islander	1.5
Native American	0.5
Other	0.2
Median Household Income	
<$39,000 (ref)	32.1
$39,000-$47,999	25.4

$48,000-$62,999	24.4
$63,000 +	18.1
Location of Residence	
Large "central" counties (ref)	29.9
Large "fringe" counties	22.3
Medium counties	18.1
Small counties	9.7
Micropolitan counties	11.3
Other	8.8

While descriptive statistics are weighted for complex survey design, sample sizes (N) are unweighted in order to display actual respondents per cell.

Table 2. Length of Stay among Chronic Heart Failure Discharges by Nursing Staff Categories and Hospital Location: Healthcare Cost and Utilization Project National Inpatient Sample (2011)

	Outcome		Quartile of FTE Nurses (RNs, LPNs, NAs)					Quartile of FTE Licensed Nurses					Hospital Location/Teaching Status			
Variables	Length of stay (days) (SE) N =81,281	p-value	% Q1 (0-4.3) N=18,259	% Q2 (4.4-5.4) N=18,848	% Q3 (5.5-6.6) N=21,258	% Q4 (6.7-99) N=16,788	p-value	% Q1 (0-3.5) N=21, 529	% Q2 (3.6-5.4) N=35,802	% Q3 (5.5-6.2) N = 11,343	% Q4 (6.3-99) N = 6,412	p-value	% Rural N=9,679	% Urban Non-Teaching N =34,253	% Urban Teaching N =35,961	p-value
Length of stay (days)	6.89 (0.03)		--	--	--	--	--	--	--	--	--	--	--	--		
Number FTE RNs + LPNs + NAs																
Q1 (0 – 4.3 FTEs) (ref)	6.4 (0.11)		--	--	--	--	--	--	--	--	--	--	50.73%	28.28%	14.75%	
Q2 (4.4 – 5.4 FTEs)	6.5 (0.12)		--	--	--	--	--	--	--	--	--	--	23.65%	29.44%	22.91%	
Q3 (5.5 – 6.6 FTEs)	7.0 (0.16)		--	--	--	--	--	--	--	--	--	--	17.21%	28.68%	31.08%	
Q4 (6.7 – 99 FTEs)	6.8 (0.22)	0.1907	--	--	--	--	--	--	--	--	--	--	8.41%	13.62%	31.26%	<0.0001
Number of FTE RNs + LPNs																
Q1 (0 – 3.5 FTEs) (ref)	6.5 (0.12)		--	--	--	--	--	--	--	--	--	--	54.32%	34.44%	18.08%	
Q2 (3.6 – 5.4 FTEs)	6.6 (0.12)		--	--	--	--	--	--	--	--	--	--	40.33%	50.11%	48.09%	
Q3 (5.5 – 6.2 FTEs)	6.7 (0.28)		--	--	--	--	--	--	--	--	--	--	2.30%	9.25%	21.26%	
Q4 (6.3 – 99 FTEs)	6.5 (0.25)	0.8912	--	--	--	--	-	--	--	--	--	--	3.05%	6.25%	12.59%	<0.0001
Hospital Location																
Rural	5.5 (0.12)		25.79%	11.68%	7.73%	5.17%		23.42%	10.72%	2.12%	4.47%		--	--	--	
Urban Non-Teaching	6.5 (0.08)		47.53%	48.06%	42.59%	27.34%		48.91%	43.91%	28.18%	30.15%		--	--	--	
Urban Teaching (ref)	7.0 (0.13)	<0.0001	26.69%	40.27%	49.69%	67.56%	<0.0001	27.68%	45.37%	69.77%	65.39%	<0.0001				
Hospital-level variables																
Bed Size																
Small	6.6 (0.18)		22.28%	10.54%	10.08%	10.08%		20.2%	11.34%	6.10%	11.83%		16.75%	11.79%	12.97%	
Medium	6.3 (0.10)		25.01%	29.95%	23.64%	19.03%		25.37%	2.55%	19.21%	25.93%		16.21%	25.70%	26.13%	
Large (ref)	6.7 (0.10)	0.0329	52.71%	59.51%	66.28%	70.90%	0.0135	54.44%	63.16%	74.69%	62.23%	0.0563	67.05%	62.52%	60.92%	0.0029
Ownership/Control																
Government, nonfederal	6.3 (1.7)		13.08%	7.13%	10.35%	8.06%		12.29%	9.29%	6.52%	8.50%		20.63%	9.09%	7.47%	
Private, non-profit (ref)	6.5 (0.9)		76.27%	74.34%	72.65%	82.63%		76.27%	73.02%	83.57%	80.12%		63.00%	66.54%	87.68%	
Private, investor-owned	7.0 (2.0)	<0.0114	10.66%	18.66%	17.35%	9.31%	0.2357	11.44%	17.70%	9.93%	11.40%	0.4866	16.39%	24.37%	4.86%	<0.0001
Multi-hospital system membership																
Non-member	6.2 (0.11)		31.27%	26.76%	24.92%	19.27%		32.84%	26.26%	15.83%	15.62%		49.85%	27.46%	19.16%	
Member	6.7 (0.89)	0.0006	68.73%	73.24%	75.08%	81.00%	0.3259	67.16%	73.74%	84.17%	84.38%	0.0710	50.15%	72.55%	80.92%	<0.0001
Discharge-level variables																
Admission Type																
Emergency (ref)	6.3 (0.07)		72.91%	73.49%	68.56%	63.84%		73.05%	70.26%	65.52%	63.93%		61.82%	75.26%	68.91%	
Urgent	7.0 (0.14)		15.43%	14.80%	18.60%	23.68%		14.59%	17.77%	22.21%	23.29%		20.84%	12.77%	19.78%	
Elective	8.1 (0.22)		11.61%	11.55%	12.56%	11.92%		1.23%	1.18%	11.35%	12.56%		17.22%	11.92%	10.81%	
Other	8.1 (0.49)	<0.0001	0.19%	0.17%	0.28%	0.56%	0.0480	0.10%	0.17%	0.92%	0.25%	0.0349	0.12%	0.16%	0.50%	<0.0001
Primary Payer																
Medicare (ref)	6.6 (0.07)		81.33%	80.41%	77.43%	76.03%		80.91%	79.32%	76.26%	73.65%		83.78%	79.86%	76.26%	
Medicaid	6.7 (0.12)		6.33%	5.76%	6.52%	8.41%		6.56%	5.83%	8.92%	8.02%		4.87%	5.48%	8.21%	

Private	6.6 (0.11)		9.65%	10.67%	12.59%	11.33%		9.89%	11.56%	11.37%	12.24%		8.36%	11.44%	11.71%	
Self-Pay	6.3 (0.20)		1.41%	1.66%	2.05%	2.16%		1.43%	1.79%	1.96%	3.01%		1.29%	1.72%	2.11%	
No charge	7.7 (0.49)		0.14%	0.15%	0.26%	0.39%		0.03%	0.20%	0.39%	0.41%		0.22%	0.16%	0.24%	
Other	5.7 (0.17)	<0.0001	1.24%	1.35%	1.16%	1.69%	0.0038	1.15%	1.30%	1.09%	2.67%	<0.001	1.67%	1.39%	1.48%	<0.0001
Patient-level variables																
Age (binary)																
Under 65	6.6 (0.07)		22.17%	23.26%	26.21%	29.85%		22.67%	24.17%	30.45%	31.05%		20.14%	22.93%	29.01%	
65 or older (ref)	6.5 (0.09)	0.0182	77.83%	76.74%	73.79%	70.21%	<0.0001	77.33%	75.84%	69.56%	68.95%	<0.0001	79.87%	77.08%	70.99%	<0.0001
Sex																
Male	6.6 (0.07)		44.79%	46.32%	47.45%	49.15%		44.75%	46.88%	49.29%	49.91%		43.85%	46.34%	48.08%	
Female (ref)	6.6 (0.07)	0.9232	55.21%	53.68%	52.55%	50.85%	<0.0001	55.25%	53.12%	50.71%	50.09%	<0.0001	56.15%	53.66%	51.92%	<0.0001
Race/ethnicity																
White (ref)	6.6 (0.07)		72.09%	73.61%	72.49%	65.43%		72.59%	72.92%	66.66%	64.45%		81.67%	74.84%	64.05%	
Black	6.6 (0.12)		15.54%	17.36%	16.57%	19.35%		15.81%	16.88%	18.57%	20.40%		12.82%	13.61%	23.67%	
Hispanic	6.4 (0.15)		7.32%	5.69%	6.77%	9.51%		6.58%	6.69%	8.48%	10.19%		2.09%	7.64%	7.41%	
Asian or Pacific Islander	6.7 (0.25)		1.81%	1.36%	1.50%	1.66%		1.70%	1.38%	1.57%	2.23%		0.41%	1.48%	1.79%	
Native American	5.9 (0.30)		0.90%	0.39%	0.26%	0.49%		0.82%	0.28%	0.26%	0.99%		1.82%	0.27%	0.29%	
Other	7.5 (0.41)	0.0227	2.33%	1.59%	2.41%	3.65%	0.3933	2.50%	1.85%	4.47%	1.74%	0.3503	1.19%	2.18%	2.83%	<0.0001
Median Household Income																
<$39,000 (ref)	6.6 (0.10)		32.34%	28.87%	31.68%	32.99%		32,82%	30.89%	31.53%	29.74%		59.32%	24.14%	31.52%	
$39,000-$47,999	6.4 (0.90)		27.35%	26.03%	2.37%	25.06%		26.97%	25.05%	24.04%	25.29%		31.81%	26.29%	22.60%	
$48,000-$62,999	6.6 (0.08)		22.72%	2.51%	2.63%	24.56%		22.12%	25.64%	25.95%	26.39%		6.97%	28.55%	25.79%	
$63,000 +	6.7 (0.12)	0.1436	17.58%	20.00%	18.31%	17.39%	0.7978	18.10%	18.42%	18.48%	18.57%	0.9079	1.90%	21.05%	20.20%	<0.0001
Location of Residence																
Large "central" counties (ref)	6.9 (0.15)		29.85%	27.20%	30.47%	39.51%		28.89%	28.57%	3.69%	4.67%		0.25%	27.56%	41.78%	
Large "fringe" counties	6.6 (0.11)		25.17%	32.50%	17.28%	14.7%		26.25%	22.19%	21.73%	13.14%		1.22%	30.73%	21.18%	
Medium counties	6.5 (0.11)		11.68%	13.36%	23.96%	20.65%		12.54%	20.13%	22.02%	11.82%		1.35%	21.11%	18.17%	
Small counties	6.4 (0.13)		4.66%	9.36%	11.18%	9.91%		5.40%	10.65%	8.09%	11.86%		1.58%	13.31%	8.93%	
Micropolitan counties	6.1 (0.12)		1.67%	10.00%	9.29%	7.95%		15.31%	10.31%	6.21%	8.55%		58.11%	3.52%	4.94%	
Other	6.3 (0.13)	0.0006	11.95%	7.58%	7.82%	7.28%	<0.001	11.61%	8.15%	5.05%	7.93%	0.0219	37.48%	3.77%	5.01%	<0.0001

While analyses are weighted for complex survey design, sample sizes (N) are unweighted in order to display actual respondents per cell. For all columns, p-values come from bivariate statistical tests to detect significant differences among means (adjusted Wald tests) or group percentages (design-based F tests).

Because location/teaching status is a main variable of interest, I ran a sensitivity analysis excluding the variable from both regressions, though no findings changed significance. Results of the negative binomial regressions of LOS onto two models of covariates are displayed in Table 3. The first regression, Model 1, examined *total* FTE nurses (RNs, LPNs, and NAs) as the main independent variable, whereas Model 2 examined just FTE *licensed* nurses (RNs and LPNs). In both models, when controlling for all variables, neither of the nurse staff variables were significant. Other significant covariates are discussed below.

In Model 1, urban teaching hospitals had a 1.33 higher times LOS compared to rural hospitals and a 1.05 higher times compared to urban non-teaching. Hospitals classified as having a large bed size had 1.08 higher LOS than those classified as a medium bed size. Compared to private, non-profit hospitals, government hospitals had a 1.08 higher times LOS and private investor-owned hospitals had a 1.10 higher times LOS. Among all CHF hospital admissions, urgent admissions had a 1.11 higher times LOS, elective admissions had a 1.30 higher times LOS, and newborn, trauma or other admissions had a 1.23 higher times LOS compared to emergency admissions. Patients who were discharged with CHF and paying with Medicaid had a 1.06 higher times LOS compared to those paying with Medicare, while no charge patients had a 1.16 higher LOS and patients paying with other methods had a 0.90 lower times LOS. When controlling for all other factors, adults aged 65 or older with a CHF diagnosis had a 1.06 times higher times LOS compared to patients below the age of 65. Compared to patients who live in large central counties with populations greater than 1 million, patients who live in large fringe counties had a 0.94 lower times LOS, those in medium counties had a 0.90 lower times LOS, and those who live in small counties had a 0.92 lower times LOS. When controlling for all other variables, race and patient's median household income did not have a significant association with the number of total FTE nurses and LOS.

In Model 2, urban teaching hospitals had a 1.35 higher times LOS compared to rural hospitals and a 1.06 higher times compared to urban non-teaching. Hospitals classified as having a large bed size have 1.08 higher LOS than those classified as a medium bed size. Compared to private non-profit hospitals, government hospitals had a 1.02 higher times LOS and private investor-owned hospitals had a 1.10 higher times LOS. Among all CHF hospital admissions, urgent admissions had a 1.12 higher times LOS, elective admissions had a 1.30 higher times LOS, and newborn, trauma or other admissions had a 1.23 higher times LOS compared to emergency admissions. Patients who were discharged with CHF and paying with Medicaid had a 1.06 higher times LOS compared to those paying with Medicare, while no charge patients had a 1.16 higher LOS and patients paying with other methods had a 0.90 lower LOS. Adults 65 or older with a CHF diagnosis also had a 1.06 times higher times LOS compared to patients below the age of 65. Compared to patients who live in large central counties with population greater than 1 million, patients who live in fringe counties have 0.94 lower times LOS, patients who live in medium counties have 0.90 lower time LOS, and patients who live in small counties have 0.92 lower times LOS. Similar to the total FTE nurse staff variable, when controlling for all other variables, race and patient's median household income did not have a association with the number of FTE licensed nurses and LOS.

Table 3. Incidence Rate Ratios of Length of Stay, Healthcare Cost and Utilization Project National Inpatient Sample (2011) (Weighted Negative Binomial Regression)

Variables	Model 1			Model 2		
	Total FTE Nurses (RNs, LPNs, NAs)			Licensed FTE Nurses (RNs +LPNs)		
	Adj. IRR	95% CI	p-value	Adj. IRR	95% CI	p-value
Quartile FTE RNs + LPNs + NAs						
Q1 (ref) (0 – 4.3 FTEs)	--	--	--	--	--	--
Q2 (4.4 – 5.4 FTEs)	0.97	(0.91, 1.03)	0.305	--	--	--
Q3 (5.5 – 6.6 FTEs)	0.97	(0.91, 1.03)	0.344	--	--	--
Q4 (6.7 – 99 FTEs)	1.01	(0.93, 1.10)	0.796	--	--	--
Quartile of FTE RNs + LPNs						
Q1 (ref) (0 – 3.5 FTEs)	--	--	--	--	--	--
Q2 (3.6 – 5.4 FTEs)	--	--	--	0.95	(0.90, 1.01)	0.092
Q3 (5.5 – 6.2 FTEs)	--	--	--	0.96	(0.87, 1.05)	0.348
Q4 (6.3 – 99 FTEs)	--	--	--	0.98	(0.89, 1.07)	0.638
Hospital Location/Teaching Status						
Rural	0.75	(0.70, 0.82)	<0.0001	0.74	(0.69, 0.81)	<0.0001
Urban Non-Teaching	0.95	(0.90, 1.00)	0.052	0.94	(0.89, 0.99)	0.027
Urban Teaching (ref)	--	--	--	--	--	--
Hospital-level variables						
Bed Size						
Small	0.96	(0.90, 1.02)	0.171	0.95	(0.89, 1.01)	0.128
Medium	0.93	(0.89, 097)	0.003	0.93	(0.88, 0.97)	0.002
Large (ref)	--	--	--	--	--	--
Ownership/Control						
Government, nonfederal	1.02	(0.96, 1.08)	0.550	1.02	(0.89, 1.01)	0.128
Private, non-profit (ref)	--	--	--	--	--	--
Private, investor-owned	1.10	(1.03, 1.17)	0.007	1.10	(0.88, 0.97)	0.002
Multi-hospital system membership						
Non-member	1.00	(0.95, 1.05)	0.943	0.99	(0.94, 1.05)	0.826
Member	---	--	--	--	--	--
Discharge-level variables						
Admission Type						
Emergency (ref)	--	--	--	--	--	--
Urgent	1.11	(1.07, 1.15)	<0.0001	1.12	(1.07 1.16)	<0.0001
Elective	1.30	(1.23, 1.37)	<0.0001	1.30	(1.23, 1.38)	<0.0001
Other	1.23	(1.05, 1.43)	0.009	1.23	(1.06, 1.44)	0.007
Primary Payer						
Medicare (ref)	--	--	--	--	--	--
Medicaid	1.06	(1.02, 1.10)	0.002	1.06	(1.02, 1.10)	0.002
Private	1.02	(0.99, 1.05)	0.170	1.02	(0.99, 1.05)	0.173
Self-Pay	0.99	(0.92, 1.06)	0.815	0.99	(0.92, 1.07)	0.828
No charge	1.15	(1.01, 1.30)	0.032	1.16	(1.02, 1.31)	0.026
Other	0.89	(0.83, 0.96)	0.002	0.89	(0.83, 0.96)	0.001
Patient-level variables						
Age (binary)						
Under 65	0.94	(0.92, 0.97)	<0.0001	0.94	(0.92, 0.97)	<0.0001
65 or older	--	--	--			
Sex						
Male	--	--	--	--	--	--
Female	1.00	(0.99, 1.02)	0.801	1.00	(0.99, 1.02)	0.863
Race/ethnicity						

White (ref)	--	--	--	--	--	--
Black	0.99	(0.96, 1.03)	0.784	0.99	(0.96, 1.03)	0.785
Hispanic	0.98	(0.91, 1.05)	0.513	0.97	(0.91, 1.05)	0.532
Asian or Pacific Islander	1.06	(0.96, 1.16)	0.254	1.05	(0.96, 1.15)	0.287
Native American	0.94	(0.81, 1.09)	0.433	0.94	(0.81, 1.09)	0.414
Other	1.12	(1.03, 1.23)	0.011	1.13	(1.02, 1.24)	0.012
Median Household Income						
<$39,000 (ref)	--	--	--	--	--	--
$39,000-$47,999	1.01	(0.98, 1.04)	0.629	1.00	(0.97, 1.04)	0.655
$48,000-$62,999	1.01	(0.98, 1.04)	0.679	1.00	(0.98, 1.04)	0.647
$63,000 +	1.04	(0.99, 1.08)	0.089	1.04	(1.00, 1.08)	0.083
Location of Residence						
Large "central" counties (ref)	--	--	--	--	--	--
Large "fringe" counties	0.94	(0.90, 0.99)	0.011	0.94	(0.90, 0.98)	0.007
Medium counties	0.90	(0.85, 0.96)	0.001	0.90	(0.85, 0.95)	<0.0001
Small counties	0.92	(0.86, 0.97)	0.007	0.92	(0.86, 0.98)	0.008
Micropolitan counties	0.99	(0.93, 1.06)	0.804	0.99	(0.93, 1.06)	0.787
Other	0.97	(0.91, 1.04)	0.399	0.97	(0.91, 1.04)	0.393

Adjusted incidence rate ratios (Adj. IRRs) are weighted to be nationally-representative of hospital inpatient discharges for a diagnosis of CHF and standard errors account for complex survey design. Numbers in the column percentages presented in this table may not add up to the total sample size due to missingness. Sample sizes (N) are unweighted in order to display actual respondents per cell. For all columns, p-values come from bivariate statistical tests to detect significant differences among adjusted IRRs either relative to the reference group (for categorical variables) or relative to a one-unit increase in continuous variables.

DISCUSSION

This study examined the association of LOS among patients with a diagnosis of CHF with primary independent variables of interest – nursing staff/skill and hospital location/teaching – controlling for a number of other hospital- and patient-level characteristics. The main results of this study indicate that nurse staffing or skill mix does not significantly impact LOS; however longer LOS was observed in urban teaching hospital settings, private-investor owned hospitals, non-emergency admissions, those under 65 years of age, hospitals with small or large bed size, members of multi-hospital system membership, and more dense urban regions. The findings are discussed in the context of the literature below.

While patients discharged with CHF from rural hospitals had an average LOS of 5.5 days, patients discharged from urban teaching hospitals had an average LOS of 7.0 days. The significant difference between LOS for rural hospitals versus urban teaching hospitals is consistent with previous literature that found teaching hospitals are associated with higher LOSs likely related to the use of more medical research activities and diagnostic procedures used by resident physicians (Hyder, Sachs, Ejaz, Spolverato, & Pawlik, 2013; Lorch et al., 2004; Yuan et al., 2000).

While the findings in this study cannot provide clear insight to this question, the significantly longer LOS in urban teaching hospitals leads one to question whether the patient receives higher quality care during their longer stay or simply more diagnostic tests and procedures. Although few studies have questioned this finding, literature indicates that overall quality of care is rated better in teaching hospitals by physicians because they are likely to have better care processes instituted (Ayanian & Weissman, 2002).

Although the data did not allow for this type of analysis, the difference in LOSs for both rural and urban teaching hospitals also leads one to question whether these stays are associated with higher readmission and mortality rates. While literature suggests that elderly patients being admitted to hospitals with short average LOSs, such as rural hospitals, have an increased risk of early readmission (Heggestad, 2002), literature also suggests that longer LOSs for CHF have been found to be associated with risk of hospital readmission and mortality within 30 days (Reynolds et al., 2015). However, due to limitations with the data, this study was not able to examine the relationship between LOS and readmission rate.

Because teaching hospitals are mainly located in urban settings with a more diverse population, they typically have higher-case mix indices and serve a poorer population, which could explain why they have higher LOSs. Consistent with literature, urban teaching hospitals in this study served a higher population of Medicaid and self-pay patients and had a higher LOS (Lorch et al., 2004). Patients under the age of 65 in this study were found to have significantly longer LOSs than patients above the age of 65. Furthermore, urban teaching-hospitals treated a higher percentage of patients under the age of 65 compared to rural and urban non-teaching hospitals. Research indicates that patients under the age of 65 are likely have more complex cases that require more intense treatment (Voors & Van der Meer, 2013), which could explain why they seek care at urban teaching hospitals. This could also partly explain why urban teaching hospitals have longer LOSs than rural and urban non-teaching hospitals.

Urban teaching hospitals in this study also had significantly higher percentages of total FTE nurses and FTE licensed nurses. Because teaching hospitals have a commitment to education these hospitals may be more likely to hire more FTE nurses for educational purposes. Previous studies suggest that appropriate RN staff as a proportion of all nurses can lead to organization readiness for quality initiatives and in turn better quality outcomes (Newhouse et al., 2013); however simply because urban hospitals have more total FTE nurses and FTE licenses nurses does not mean they have the appropriate ratio and proportion.

Although there were statistically significant differences in nurse staffing by hospital location/teaching status in bivariate analyses, when controlling for all other hospital and patient-level variables the nursing staff variables were not significantly associated with LOS. These results could be related to limitations in the data and lack of control variables, such as readmission rates, case-mix index, disease severity, and comorbidities. As suggested by literature, CHF patients with longer LOSs typically have more comorbidities and higher disease severity (Whellan et al., 2011). According to the previously mentioned study, I stratified LOS into three different categories as a sensitivity analysis to test if the lack of significance was being confounded by disease severity and comorbidities; however, again there was no significant association between nursing staff quartiles and LOS.

LIMITATIONS

Several limitations occurred with this study. Because the NIS data is a stratified sample of hospitals, the sampling frame is limited by the availability of inpatient data from the sources participating in HCUP. Furthermore, because no unique patient identifiers are assigned to the data, readmissions cannot be tracked; therefore some of the CHF admissions may be from the same patient, and these patients are likely more complicated cases. While LOS can be one measure of hospital efficiency and quality, many other indictors can be used to measure quality outcomes. Further, while CHF is a major contributor to patient morbidity and hospital readmission and was thus chosen as a representation of an important, vulnerable patient population that is important to CMS' hospital performance evaluations, other contexts need to be explored. Future research should continue to examine the impact nurses have on quality of care and patient experience. While the study used two variables to assess staff and skill mix of the nurses to an extent, it would have also been beneficial to analyze the difference between an RN with a bachelor of science in nursing (BSN) and an RN with an Associates degree; however the data did not allow for this analysis.

CONCLUSION

Because one of the main goals of the Affordable Care Act was to implement a hospital value-based purchasing program, improving quality of care is and will continue to be a priority. This study confirms that differences between hospital settings have an impact on LOS for patients with CHF. With LOS being one of the many outcome measures used by CMS when evaluating hospitals performance for CHF treatment for payment under the value-based purchasing plan (Centers for Medicare and Medicaid Services, 2015), it is important to understand why these differences in LOS occur. Future studies should focus on examining the differences between hospital setting and patient outcomes, as well as other hospital and patient-level factors that lead to differences in LOS and other quality measures. Such a focus has the opportunity to influence how hospitals design quality process improvements and implement initiatives to improve patient care, which will ultimately have an impact on patient outcomes and overall health. Although this study did not find a significant association between nurse staffing and LOS, it did find that LOS was significantly influenced by hospital location/teaching status, along with several other hospital and patient level-characteristics, including investor-owned hospital control, admission type, patient age, and patient location of residence. Nonetheless, it will be important for future studies to examine the influence of nurse staffing on patient outcomes in order to improve staffing patterns and determine adequate staffing levels. Comparing patient outcomes, quality of care, and nurse staffing levels provided in different hospital settings can give insight to the best and most efficient practices and help hospitals ensure they are providing the best quality of care to patients with chronic heart failure.

Appendix A

Stata Code

```
*1:1 merge of DX into CORE by HOSPID and KEY
merge 1:1 HOSPID KEY using "Y:\CMeinert\StataDatasets\ORGINAL
NIS_2011_DX_PR_GRPS.dta"

*m:1 merge of Hospital file into CORE_DX by HOSPID (no KEY in Hospital file)
merge m:1 HOSPID using "Y:\CMeinert\StataDatasets\ORGINAL NIS_2011_Hospital.dta",
generate(_merge2)

save "Y:\CMeinert\StataDatasets\MergeHospital_mto1_CoreDx.dta"

*Set complex survey design setting
svyset HOSPID [pweight=DISCWT], strata(NIS_STRATUM) psu(HOSPID)

*Checking Descriptives to see how many people have CHF (and ensure it is enough to study)
tab if DXCCS7==108
*Getting mean and standard deviation of outcome variable (must be unweighted)
sum LOS if NIS_STRATUM!=0 & DXCCS7==108
	*From this I can see that the variance (SD squared) is going to be MUCH larger than the
	mean.
	*In this case, the unweighted mean is 6.89 and the variance is ~54.
	*So, LOS is "over-dispersed"

*Histogram of LOS variable
	histogram LOS if NIS_STRATUM!=0 & DXCCS7==108, discrete
	histogram LOS if (NIS_STRATUM!=0 & DXCCS7==108 & LOS<40), discrete
	*From this it looks like it is definitely NOT zero-inflated
	*How to choose the count variable regression model type
	*http://www.ats.ucla.edu/stat/stata/dae/zinb.htm

*NURSE STAFFING VARIABLES
	*Literature that used similar variables http://www.ncbi.nlm.nih.gov/pubmed/25304017
```

*Creating new quartiled variable for HOSP_RNFTE
generate RNFTE=1 if HOSP_RNFTE <=3.2
replace RNFTE=2 if HOSP_RNFTE >3.3 & HOSP_RNFTE <=4.1
replace RNFTE=3 if HOSP_RNFTE >4.2 & HOSP_RNFTE <5.3
replace RNFTE=4 if HOSP_RNFTE >5.4 & HOSP_RNFTE <99
*Creating new variable to combine Total FTE Nurses (RNs, LPNs, NAs) per 1000 inpatient days
gen TOTAL_NurseFTE= HOSP_RNFTEAPD+ HOSP_LPNFTEAPD+ HOSP_NAFTEAPD
*replacing missing if <1 and including if at least one RN, LPN, or NA>1 (extreme outliers)

replace TOTAL_NurseFTE=HOSP_LPNFTEAPD + HOSP_NAFTEAPD if HOSP_LPNFTEAPD>1 & HOSP_NAFTEAPD>1 & HOSP_RNFTEAPD==.
replace TOTAL_NurseFTE=HOSP_LPNFTEAPD if HOSP_LPNFTEAPD>1 & HOSP_NAFTEAPD==. & HOSP_RNFTEAPD==.

*Checking to see missing
count if HOSP_RNFTEAPD==. & HOSP_LPNFTEAPD==. & HOSP_NAFTEAPD>1 & HOSP_NAFTEAPD<99

*Summarizing new variable to look at % quartiles
sum TOTAL_NurseFTE, de

*Creating Quartile Variable for the Total Number of Nurses(1-4)
gen cat_TOTAL_NurseFTE=.
replace cat_TOTAL_NurseFTE=1 if TOTAL_NurseFTE<=4.3
replace cat_TOTAL_NurseFTE=2 if TOTAL_NurseFTE > 4.4 & TOTAL_NurseFTE <= 5.4
replace cat_TOTAL_NurseFTE=3 if TOTAL_NurseFTE > 5.5 & TOTAL_NurseFTE<=6.6
replace cat_TOTAL_NurseFTE=4 if TOTAL_NurseFTE> 6.7 & TOTAL_NurseFTE < 99
tab cat_TOTAL_NurseFTE

*Creating new variable to combine licensed nurses (RNs and LPNs)FTEs per 1000 inpatient days
gen FTE_licensednurse= HOSP_RNFTEAPD + HOSP_LPNFTEAPD
list HOSP_RNFTEAPD HOSP_LPNFTEAPD if HOSP_RNFTEAPD==. & HOSP_LPNFTEAPD<99
count if HOSP_RNFTEAPD==. & HOSP_LPNFTEAPD<99
*replacing missing if <1 and including if at least one RN or LPN>1
replace FTE_licensednurse=HOSP_LPNFTEAPD if HOSP_LPNFTEAPD>1 & HOSP_RNFTEAPD==.

*Creating Quartile Variable for Licensed Nurses (1-4)
gen cat_FTE_licensednurse=.

```
    replace cat_FTE_licensednurse=1 if FTE_licensednurse <=3.5
    replace cat_FTE_licensednurse=2 if FTE_licensednurse >3.6 &
    FTE_licensednurse <=5.4
    replace cat_FTE_licensednurse=3 if FTE_licensednurse >5.5 & FTE_licensednurse
    <=6.2
    replace cat_FTE_licensednurse=4 if FTE_licensednurse >6.3 & FTE_licensednurse < 99
    tab cat_FTE_licensednurse

*Recoding ATYPE
replace ATYPE=4 if (ATYPE==4 | ATYPE==5 | ATYPE==6)
replace ATYPE=. if ATYPE==0
clonevar hosptype = ATYPE
replace hosptype=4 if (ATYPE==4 | ATYPE==5 | ATYPE===6)

*Recoding HOSP_LOCTEACH
replace HOSP_LOCTEACH=. if HOSP_LOCTEACH==0

*Recoding RACE
replace RACE=. if RACE==0

*Recoding median household income
replace ZIPINC_QRTL=. if ZIPINC_QRTL==0

*Recoding hospital bedsize
replace HOSP_BEDSIZE=. if HOSP_BEDSIZE==0

*Recoding H_CONTRL
replace H_CONTRL=. if H_CONTRL==0

*Labeling New Variables
    label var TOTAL_NurseFTE "Total FTE Nursing Staff per 1000 Inpatient Days"
    label var cat_TOTAL_NurseFTE "Quartiled FTE Total Nursing Staff per 1000
    Inpatient Days"
    label var FTE_licensednurse "Total FTE Licensed Nurses per 1000 Inpatient
    Days"
    label var cat_FTE_licensednurse "Quartiled FTE Licensed Nurses per 1000 Inpatient
    Days"

*Generate new variable where CHF discharge is 1 and not is 0
generate chf=0
replace chf=1 if DXCCS7==108
*Generate age category variable
    clonevar AGECAT = AGE
    replace AGECAT = 0 if (AGE>=0 & AGE<25)
    replace AGECAT = 1 if (AGE>=25 & AGE<50)
    replace AGECAT = 2 if (AGE>=50 & AGE<65)
```

```
replace AGECAT = 3 if (AGE>=65 & AGE<75)
replace AGECAT = 4 if (AGE>=75 & AGE<85)
replace AGECAT = 5 if (AGE>=85 & AGE<95)
replace AGECAT = 6 if (AGE>=95 & AGE<130)
```

*Second binary age category (reference group 65+ to capture Medicare effect)

```
clonevar AGEBINARY = AGE
replace AGEBINARY = 0 if (AGE>=65 & AGE!=.)
replace AGEBINARY = 1 if (AGE<65 & AGE!=.)
label define AGEBINARYL 0 "65+" 1 "Under 65"
label values AGEBINARY AGEBINARYL
```

*Labeling variables (one example below)

```
label define racel 1 "White" 2 "Black" 3 "Hispanic" 4 "Asian or Pacific Islander" 5
"Native American" 6 "Other"
label values RACE racel
label define PL_NCHS2006l 1 "Central counties of metro areas of ≥ 1 million
population" 2 "Fringe counties of metro areas of ≥ 1 million population" 3 "Counties in
metro areas of 250,000-999,000 population" 4 "Counties in metro areas of 50,000 –
249,999 population" 5 "Micropolitan counties" 6 "Not metro or micro counties"
label values PL_NCHS2006 PL_NCHS2006l
label define income 1 "$1-$38,999" 2 "$39,000-47,999" 3 "$48,000-$62,999" 4 "$63,000
or more"
label values ZIPINC_QRTL income
label define atypeL 1 "Emergency" 2 "Urgent" 3 "Elective" 4 "Newborn|Trauma
Center|Other"
label values ATYPE atypeL
label define payl 1 "Medicare" 2 "Medicaid" 3 "Private including HMO" 4 "self-pay" 5
"No charge" 6 "Other"
label values PAY1 payl
label define RNFTEl 1 "Less than 3.2 FTEs" 2 " 3.3-4.1 FTEs" 3 "4.2-5.3 FTEs"
4 "5.4 or more FTEs"
label values RNFTE RNFTEl
label define Total_NurseFTEl 1 "Less than 4.3 FTEs" 2 "4.4-5.4 FTEs" 3 "5.4-6.6
FTEs" 4 "6.6 or more FTEs"
label values cat_TOTAL_NurseFTE Total_NurseFTEl
label define FTE_licesednurseL 1 "Less than 3.5 FTEs" 2 "3.6-5.4 FTEs" 3 "5.4-
6.2 FTEs" 4 "6.2 or more FTEs"
label values cat_FTE_licensednurse FTE_licesednurseL
label define locationl 0 "Rural" 1 "Urban"
label values HOSP_LOCATION locationl
label define bedsizel 1 "Small" 2 "Medium" 3 "Large"
label values HOSP_BEDSIZE bedsizel
label define hospcontrolL 0 "Government or private" 1 "Government, nonfederal, public"
2 "Private, non-profit, voluntary" 3 "Private, investor owned" 4 "Private"
label values HOSP_CONTROL hospcontrolL
```

```
	label define hosp_locteachL 1 "Rural" 2 "Urban Non-teaching" 3 "Urban teaching"
	label values HOSP_LOCTEACH hosp_locteachL
	label define hosp_membership 0 "Non-member" 1 "Member"
	label values HOSP_MHSMEMBER hosp_membership
	label define AGECATL 0 "0-24" 1 "25-49" 2 "50-64" 3 "65-74" 4 "75-84" 5 "85-94" 6
	"95+"
	label values AGECAT AGECATL
	label define H_CONTRLL 1 "Government, nonfederal" 2 "Private, non-profit
	(voluntary)" 3 "Private, investor-owned (proprietary)"
	label values H_CONTRL H_CONTRLL

*TABLE 1
*Generating Descriptives of Patient-Level Variables
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): mean AGE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab AGECAT
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab AGEBINARY
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab FEMALE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab RACE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab PL_NCHS2006
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab ZIPINC_QRTL

*Generating Descriptives of Discharge-Level Variables
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40):tab ATYPE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40):tab PAY1

*Generating Descriptive of Nursing Staff
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): mean HOSP_RNFTE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab RNFTE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): mean HOSP_RNPCT
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): mean TOTAL_NurseFTE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): mean FTE_licensednurse
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab cat_TOTAL_NurseFTE,
obs
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab cat_FTE_licensednurse

*Generating Descriptive of Location Variable
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab HOSP_LOCTEACH

*Genrating Descriptive of Hospital-level Variables
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab HOSP_BEDSIZE
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab H_CONTRL
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab HOSP_LOCTEACH
svy, subpop(if NIS_STRATUM!=0 & DXCCS7==108 & LOS<40): tab HOSP_MHSMEMBER

*TABLE 2
*By Length of Stay
```

*Bivariate coding for Nurse Staffing (Main Predictor #1)
*Don't run this. This one will not be useful because there are so many percentage values
*RUN this when we get to regression, but not useful for bivariate table
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(HOSP_RNPCT)

*Run the ones where you have made them categorical:
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(RNFTE)

*Global test - testing if mean LOS across ALL RNTFE values are different from another in one statistic
test [LOS]1 = [LOS]2 = [LOS]3 = [LOS]4

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(cat_TOTAL_NurseFTE)
test [LOS]_subpop_1 = [LOS]_subpop_2 = [LOS]_subpop_3 = [LOS]_subpop_4

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(cat_FTE_licensednurse)
test [LOS]_subpop_1 = [LOS]_subpop_2 = [LOS]_subpop_3 = [LOS]_subpop_4

*Bivariate coding for Location (Main Predictor #2)
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(HOSP_LOCTEACH)
test [LOS]Rural = [LOS]_subpop_2 = [LOS]_subpop_3

*Bivariate coding for additional discharge-level variables
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(ATYPE)
test [LOS]Emergency = [LOS]Urgent = [LOS]Elective = [LOS]_subpop_4

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(PAY1)
test [LOS]Medicare = [LOS]Medicaid = [LOS]_subpop_3 = [LOS]_subpop_4 =[LOS]_subpop_5 = [LOS]Other

*Bivariate coding for additional patient-level variables
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(FEMALE) test [LOS]0 = [LOS]1

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(AGECAT)
test [LOS]_subpop_1 = [LOS]_subpop_2 = [LOS]_subpop_3 = [LOS]_subpop_4 = [LOS]_subpop_5= [LOS]_subpop_6= [LOS]_subpop_7

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(AGEBINARY)
test [LOS]_subpop_1 = [LOS]_subpop_2

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(RACE)

test [LOS]White = [LOS]Black = [LOS]Hispanic = [LOS]_subpop_4 = [LOS]_subpop_5
= [LOS]Other

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(PL_NCHS2006)
test [LOS]_subpop_1 = [LOS]_subpop_2 = [LOS]_subpop_3 = [LOS]_subpop_4 =
[LOS]_subpop_5= [LOS]_subpop_6

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(ZIPINC_QRTL)
test [LOS]_subpop_1 = [LOS]_subpop_2 = [LOS]_subpop_3 = [LOS]_subpop_4

*Bivariate coding for addtional hospital level variables
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over(HOSP_BEDSIZE)
test [LOS]Small = [LOS]Medium = [LOS]Large

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over (H_CONTRL)
test [LOS]_subpop_1 = [LOS]_subpop_2 = [LOS]_subpop_3

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): mean LOS, over
(HOSP_MHSMEMBER)
test [LOS]_subpop_1 = [LOS]Member

*By TOTAL FTE Nurses (RNs, LPNs, CNAs)
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_LOCTEACH
cat_TOTAL_NurseFTE, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab ATYPE cat_TOTAL_NurseFTE,
obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab PAY1 cat_TOTAL_NurseFTE,
obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab AGECAT
cat_TOTAL_NurseFTE, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab FEMALE
cat_TOTAL_NurseFTE, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab RACE cat_TOTAL_NurseFTE,
obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab PL_NCHS2006
cat_TOTAL_NurseFTE, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab ZIPINC_QRTL
cat_TOTAL_NurseFTE, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_BEDSIZE
cat_TOTAL_NurseFTE, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab H_CONTRL
cat_TOTAL_NurseFTE, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_MHSMEMBER
cat_TOTAL_NurseFTE, obs column

*Binary age

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab AGEBINARY cat_TOTAL_NurseFTE, obs column

*By all FTE licensed nurses
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_LOCTEACH cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab ATYPE cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab PAY1 cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab AGECAT cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab FEMALE cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab RACE cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab PL_NCHS2006 cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab ZIPINC_QRTL cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_BEDSIZE cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab H_CONTRL cat_FTE_licensednurse, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_MHSMEMBER cat_FTE_licensednurse, obs column

*Binary age
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab AGEBINARY cat_FTE_licensednurse, obs column

*By Urban/Rural Teaching
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab RNFTE HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab cat_TOTAL_NurseFTE HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab cat_FTE_licensednurse HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab ATYPE HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab PAY1 HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab AGECAT HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab FEMALE HOSP_LOCTEACH, obs column

```
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab RACE HOSP_LOCTEACH,
obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab PL_NCHS2006
HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab ZIPINC_QRTL
HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_BEDSIZE
HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab H_CONTRL
HOSP_LOCTEACH, obs column
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab HOSP_MHSMEMBER
HOSP_LOCTEACH, obs column

*Binary age
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): tab AGEBINARY
HOSP_LOCTEACH, obs column

*Correlation matrix of covariates
corr cat_TOTAL_NurseFTE cat_FTE_licensednurse AGE FEMALE RACE PL_NCHS2006
ZIPINC_QRTL ATYPE PAY1 HOSP_BEDSIZE H_CONTRL HOSP_LOCTEACH
HOSP_MHSMEMBE
corr cat_TOTAL_NurseFTE cat_FTE_licensednurse AGE FEMALE RACE PL_NCHS2006
ZIPINC_QRTL ATYPE PAY1 HOSP_BEDSIZE H_CONTRL HOSP_LOCTEACH
HOSP_MHSMEMBE if (NIS_STRATUM!=0 & chf==1 & LOS<40)

*Looking to see if Correlation between RNFTE and HOSP_RNPCT
corr cat_TOTAL_NurseFTE cat_FTE_licensednurse RNFTE HOSP_RNPCT AGE FEMALE
RACE PL_NCHS2006 ZIPINC_QRTL ATYPE PAY1 HOSP_BEDSIZE H_CONTRL
HOSP_LOCTEACH HOSP_MHSMEMBE

*First regression is without Hospital Location/Teaching Status
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): nbreg LOS i.cat_TOTAL_NurseFTE
AGE FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL i.ATYPE i.PAY1
ib3.HOSP_BEDSIZE ib2.H_CONTRL ib1.HOSP_MHSMEMBER, irr

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): nbreg LOS i.cat_FTE_licensednurse
AGE FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL i.ATYPE i.PAY1
ib3.HOSP_BEDSIZE ib2.H_CONTRL ib1.HOSP_MHSMEMBER, irr


 *The second regression includes Hospital Location/Teaching Status
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): nbreg LOS i.cat_FTE_licensednurse
AGE FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL i.ATYPE i.PAY1
ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH ib1.HOSP_MHSMEMBER, irr
```

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): nbreg LOS
i.cat_TOTAL_NurseFTE AGE FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL i.ATYPE
i.PAY1 ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH
ib1.HOSP_MHSMEMBER, irr

*Using AGE as a categorical rather than continuous

svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): nbreg LOS i.cat_FTE_licensednurse
AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL i.ATYPE i.PAY1
ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH ib1.HOSP_MHSMEMBER, irr
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40): nbreg LOS i.cat_TOTAL_NurseFTE
AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL i.ATYPE i.PAY1
ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH ib1.HOSP_MHSMEMBER, irr

*SENSITIVITY ANALYSIS (potential future paper?) 2016 03 01
    * Will stratify by 3 ranges of LOS in CHF patients based upon the literature
    * Whellan et al. (2011) that it was useful to split CHF patients in LOS categories of:
        * <4 days, 4-7 days, 7+ days
    *So, for each of the final regression above, we'll run three by this stratification
* FTE licensed nurses
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40 & LOS<4): nbreg LOS
i.cat_FTE_licensednurse AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL
i.ATYPE i.PAY1 ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH
ib1.HOSP_MHSMEMBER, irr
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40 & (LOS>=4 & LOS<=7)): nbreg LOS
i.cat_FTE_licensednurse AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL
i.ATYPE i.PAY1 ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH
ib1.HOSP_MHSMEMBER, irr
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40 & LOS>7): nbreg LOS
i.cat_FTE_licensednurse AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL
i.ATYPE i.PAY1 ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH
ib1.HOSP_MHSMEMBER, irr

* TOTAL FTE nurses
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40 & LOS<4): nbreg LOS
i.cat_TOTAL_NurseFTE AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL
i.ATYPE i.PAY1 ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH
ib1.HOSP_MHSMEMBER, irr
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40 & (LOS>=4 & LOS<=7)): nbreg LOS
i.cat_TOTAL_NurseFTE AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL
i.ATYPE i.PAY1 ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH
ib1.HOSP_MHSMEMBER, irr
svy, subpop(if NIS_STRATUM!=0 & chf==1 & LOS<40 & LOS>7): nbreg LOS
i.cat_TOTAL_NurseFTE AGEBINARY FEMALE i.RACE i.PL_NCHS2006 i.ZIPINC_QRTL

i.ATYPE i.PAY1 ib3.HOSP_BEDSIZE ib2.H_CONTRL ib3.HOSP_LOCTEACH ib1.HOSP_MHSMEMBER, irr

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