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The Evaluation of the Effects of the Use of the Palliative Care Diagnosis Code on Risk-Adjusted Mortality and Hospital Ranking in Patients with Severe Sepsis

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THE EVALUATION OF THE EFFECTS OF THE USE OF THE PALLIATIVE CARE DIAGNOSIS CODE ON RISK-ADJUSTED MORTALITY AND HOSPITAL RANKING IN PATIENTS WITH SEVERE SEPSIS

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For my father, Bobby Neal Riddle (1935 - 2014)
There's no mail in the box.

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ABSTRACT

Background: The International Classification of Diseases, Ninth-Revision-Clinical Modification (ICD-9-CM) for palliative care (V66.7) has been shown to affect risk-adjusted mortality rates. This code can increase the risk of mortality when included in billing data and incorporated into risk-adjustment models (1).

Objectives: The purpose of this study is to examine variations in coding between high-performing (low mortality indices (Observed/Expected)) and low-performing (high mortality indices) hospitals by examining the use of the ICD-9-CM code for palliative care; coding of severe sepsis; and assignment of higher-weighted Medicare-Severity Diagnosis Related Group (MS-DRG) codes.

Methods: Data were obtained from the Vizient™ Clinical Database/Resource Manager (CBD/RM) by permission of Vizient. (All rights reserved.) Adult patients with a present-on-admission diagnosis of severe sepsis and discharged from Vizient-member hospitals during calendar year 2014 were analyzed. Severe sepsis was defined as the presence of an ICD-9-CM code for severe sepsis (995.92); septic shock (785.52); or an infection with organ dysfunction. Hospitals were ranked on their mortality index and divided into quartiles; high-performing and low-performing hospitals were compared. Categorical variables were assessed using chi-square tests; continuous variables were compared using t-tests. The analyses of palliative care code usage and MS-DRG assignment were conducted using logistic regression models.

Results: A total of 352,275 patients representing 249 hospitals met inclusion criteria. There was no statistically significant difference in frequency between high- and low-performing hospitals with which patients were coded with an infection plus organ dysfunction ($p = 0.4984$) or assignment of higher-weighted MS-DRG codes. Patients with a code for severe sepsis in low-performing hospitals had 0.14 lower odds of utilizing the palliative care code (V66.7) (odds ratio 0.86, 95% CI: 0.78 to 0.94) when compared to high-performing hospitals, after adjusting for patient and hospitalization-related characteristics, to include discharge disposition.

Conclusion: Low-performing hospitals were less likely to have V66.7 code when compared to high-performing hospitals. Patients discharged to hospice were more likely to receive the V66.7 code when compared to those who died in-hospital. This suggests that coding of palliative care may be insufficient when a patient dies in-hospital and that there are opportunities for low-performing hospitals to improve their reported metrics.

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CHAPTER ONE: INTRODUCTION

Background and Problem Statement

The healthcare environment has changed in recent years with an increased focus on demonstrated quality and transparency. The Centers for Medicare and Medicaid Services (CMS) and other such entities as The Leapfrog Group, Inc., and U.S. News and World Report, publically report hospital performance, safety and outcomes data (1, 2). These programs and reporting entities have financial implications such as loss of payment, public perception, or both. Hospitals are being evaluated and compared against each other, so the need to demonstrate performance in the top tier is imperative.

The Affordable Care Act (ACA) of 2010 includes the evaluation of hospitals utilizing quality indicators related to processes of care, patient satisfaction, patient outcomes, efficiency, and healthcare-acquired conditions. Programs such as the Hospital Value-Based Purchasing Program (HVPB), which appears in Section 3001(a) of the ACA, use quality data submitted by eligible hospitals "to link Medicare's payment system to value-based system to improve healthcare quality"(3).

The focus of the patient outcomes metric is 30-day mortality for patients with a principal diagnosis of acute myocardial infarction (AMI), heart failure (HF), pneumonia (PN) or stroke, and those patients with a principal diagnosis of Chronic Obstructive Pulmonary Disease (COPD) or principal diagnosis of respiratory failure with a secondary diagnosis of COPD exacerbation (4, 5). It should be noted that mortality outcomes are also publically reported by CMS for stroke, coronary artery bypass graft, and hip and knee replacement, but are not incorporated in the HVPB program at the time of this writing (2,3). The method with which these hospitals are compared is through hospital-specific risk-standardized mortality rates (RSMR). The RSMR is calculated by dividing a hospital's predicted mortality by its expected mortality and then multiplying the result by the national observed mortality rate (5).

The statistical models developed to calculate the RSMR utilize administrative, or claims-based, data which include important variables such as diagnoses codes (which capture comorbidities), procedure codes, demographic data and Medicare-Severity Diagnosis Related Group (MS-DRG) weights. It is imperative, therefore, that the documentation and coding is complete and accurately captures the acuity of the patient. Companies have arisen, such as 3M, which assist hospitals in facilitating Clinical Documentation Improvement (CDI) initiatives.

This focus on improved documentation in areas addressed by the CMS programs can create a "Hawthorne Effect" or as the authors of the RAND report suggest, cause hospitals to "teach to the test" (6). One of the questions put forth by the RAND report is whether or not hospitals are "gaming the system" (7). In other words, are hospitals using documentation and coding in such a way that decreases their risk-adjusted mortality rates?

For example, the code for palliative care, V66.7 (International Classification of Diseases, Ninth-Revision-Clinical Modification (ICD-9-CM), has been shown to affect risk-adjusted mortality rates. This code can increase the risk of mortality when included in billing data and incorporated into risk-adjustment models, either as a significant covariate or as a basis for exclusion from mortality rate calculation (1). While palliative care is not necessarily end-of-life care--palliative care is also utilized for healthcare goals such as pain management—the use of the code can increase the calculated risk of mortality (1). In a Canadian study conducted by Chong et al (2012), there was a notable increase in palliative care coding commencing with the November 2007 implementation of public reporting; this increase corresponded to a decreasing Hospital Standardized Mortality Rate (HSMR) (8).

This thesis does not attempt to answer the question of gaming, as the question itself implies a level of dishonesty in reporting and coding practices--an endeavor that would require time-consuming and resource-heavy medical record audits. It does, however, analyze administrative data to examine potential variations in coding practices that may contribute to differences in risk-adjusted mortality rates, including the use of the palliative care code.

The condition that was chosen for the analyses was one that has a high mortality rate and variation in how it is coded, but that not yet been proposed by CMS for public reporting—severe sepsis (9, 10). A condition that is not yet a focus of CMS may eliminate potential biases that could occur as a result of the Hawthorne Effect.

Significance

Shen and Wu conducted a study which found that decreases in Medicare payments impede efforts to reduce mortality rates (11). The authors used the Balanced Budget Act of 1997 to study long-term effects of payment cuts. The decrease in income caused a “cut back on investments in infrastructure, nursing staff, patient support services, patient safety, and quality-enhancing activities” (11). This is echoed in the RAND report which observes that a potential effect of the CMS HBVP program is that lower-performing hospitals will lose funds necessary to make improvements, setting them back even further (7).

Healthcare organizations which are able to implement Clinical Documentation Improvement (CDI) initiatives, employ CDI-focused consulting companies, or purchase CDI-related software, may be at an advantage over those hospitals which have not done, or are unable to do, the same. The resources required for improvement may be a limitation for low-performing hospitals and place them behind the well-funded hospitals. This difference in resources may manifest itself when comparing patient outcomes, one measure of which is mortality. Quality of care could be the same at both a high-performing hospital and a low-performing hospital, however, the lack of strong coding and documentation processes can create the perception of a chasm between the quality of care at both hospitals. A hospital with mortality rates above the national average can be misinterpreted to mean that the reported deaths were avoidable, when the difference could lie in the reporting of the patients’ condition through documentation and coding (12). A systematic literature review conducted by Pitches, et al, demonstrated a relationship between quality of care and risk-adjusted mortality only 51% of the time (13).

There is another very important issue to consider when looking at mortality rates--or any quality data for that matter—patient care. In order to improve care and processes, an organization needs to have an accurate assessment of the situation; in other words, the data need to be reliable. If a hospital is seeing improvement in the RSMR for a particular condition, the focus may be switched to another quality-of-care issue, even though the improvement in mortality was not a reflection of improved care or actual outcome but of improved documentation (14). Conversely, conditions that are not the focus of CMS or other payer organizations could get ignored (7).

An unintended consequence of publically reporting and incentivizing outcomes measures is the practice of not accepting patients who could worsen a hospital's results; this has occurred with patients undergoing Coronary Artery Bypass Graft surgery (CABG) and Percutaneous Coronary Intervention (PCI) (14). The needs and safety of the patient could be jeopardized by the very programs put in place that are intended to improve care and outcomes.

It is hoped that this thesis will contribute to the conversation surrounding the effects of coding on mortality rates and hospital rankings. If it adds weight to the argument that mortality rankings are a reflection of variations in hospital coding, then it will help hospitals understand the importance of excellent documentation and coding. Improved coding and documentation would be a step closer to being able to reliably compare hospitals and evaluate one's own hospital in order to change what really needs to be changed.

Study Hypotheses and Specific Aims

Specific Aim 1: To compare usage of the ICD-9-CM Code V66.7 between hospitals who have better-than-expected mortality rates ("high performers") and those who have worse-than-expected in-hospital mortality rates ("low performers") in patients coded with severe sepsis and/or septic shock.

Study Hypothesis 1: High-performing hospitals will have higher usage of the ICD-9-CM code for palliative care than low-performing hospitals.

Rationale: Hospitals are currently issued incentives or penalties under the CMS Value-Based Purchasing program based on ranking of risk-standardized mortality rates (RSMR); it is important to understand the effect of coding on the rates and subsequent rankings.

Specific Aim 2: To further examine variations in coding between low- and high-performing hospitals by determining the manner in which severe sepsis is coded and its association with utilization of the palliative care ICD-9 code.

Study Hypothesis 2: There will be a difference in practices for coding severe sepsis between low-performing and high-performing hospitals.

Rationale: There is variation in the methods by which severe sepsis is captured in administrative data (10, 15-19). Assessing the methods utilized for coding severe sepsis could reveal a correlation with palliative care code usage and provide support for the hypothesis of coding effects on hospital rankings.

Specific Aim 3: To compare the level of the Medicare-Severity Diagnosis Related Groups (MS-DRGs) assigned between low- and high-performing hospitals.

Study Hypothesis 3: Patients at high-performing hospitals will have MS-DRGs assigned that are at a higher level (weight) than those at low-performing hospitals.

Rationale: MS-DRGs are used as an indicator of patient severity and resource use; these codes are dependent on coding and documentation. Weights are assigned to every MS-DRG which are then averaged for each hospital to determine its' Case Mix Index (CMI), a significant variable in CMS RSMRs. Assessing the differences in the MS-DRG assignments between the two levels of hospitals (low- vs. high-performing) could further strengthen the effects of coding on hospital rankings.

CHAPTER TWO: REVIEW OF LITERATURE

Introduction to Chapter

This review of literature encompasses issues relevant to the current study. The chapter begins with the impetus of this study, namely the regulations, programs and financial implications faced by healthcare providers to promote transparency and drive improved healthcare quality and patient outcomes. The literature search process is then discussed with a summary of studies specific to the impact of coding on mortality rates. The chapter concludes with a discussion of the main foci of the study—mortality rates, the ICD-9-CM code for palliative care, and finally, severe sepsis.

Hospital Performance, Incentives and Public Reporting

The Affordable Care Act of 2010 has programs under the Inpatient Prospective Payment System (IPPS) which incentivize improved hospital quality and outcomes. There are several programs under IPPS, each of which carry penalties or incentives to hospitals. One particular program, Value-Based Purchasing (VBP), gives hospitals an opportunity to recoup a percentage of withheld money from Diagnosis-Related Group (DRG) payments. For Fiscal Year 2017, the fifth year of the program, there are currently five domains carrying different weights for calculating a Total Performance Score (TPS) for each eligible hospital and the amount of money to be withheld (maximum is 2.0%) (3, 4). The scores for each hospital are compared and those which have low performance scores recoup little to none of the withheld reimbursement; the money withheld from the “low” performers is used to fund the “high” performers’ incentives (20).

The domains currently being evaluated for acute inpatient discharges are Patient and Caregiver-Centered Experience of Care/Care Coordination (25%), Efficiency and Cost Reduction (25%); Safety (20%); Clinical Care—Process (5%); and Clinical Care--Outcomes (25%). Patient Experience of Care evaluates patient satisfaction with data derived from surveys submitted by patients who had a recent hospital admission. Efficiency measures Medicare Spending per Beneficiary—whether hospitals spent more or less than expected for the index admission (admission of interest). The Safety domain is a combination of various safety measures established by the Agency for Healthcare Research and Quality (AHRQ) and Healthcare-associated infection (HAI) rates collected and reported by the Centers for Disease Control’s National Healthcare Safety Network (CDC NHSN). Clinical Care—Process uses data collected to evaluate hospital adherence to established practices; as of January 1, 2015, this includes influenza immunization administration rates, receipt of a fibrinolytic within 30 minutes of hospital arrival for patients presenting with an acute myocardial infarction, and finally, the rate of elective deliveries occurring prior to 39 weeks gestation (3).

The final category is Clinical Care—Outcomes which assess 30-day mortality for Medicare Fee-For-Service patients or VA beneficiaries who were discharged from an acute care hospital with a principal diagnosis of acute myocardial infection (AMI), heart failure (HF), or pneumonia (PN). CMS utilizes a risk-standardized mortality rate for all-cause mortality that occurs within 30 days of index admission. The rationale given by CMS for 30-day mortality is that deaths within this time frame could be related to the care received or being discharged too soon (5).

The scores for these domains, and scores of other IPPS programs such as the Hospital-Acquired Condition Reduction (HAC) program and the Readmission Reduction program, are reported on the CMS website “Hospital Compare” and used by other public reporting entities such as The Leapfrog Group, Inc. Leapfrog, Inc., reports hospital performance in the form of a letter grade on their website, Hospital Safety Score®, and in press releases. The public reporting of these results, and more importantly, the incentive-based CMS program, have financial ramifications. Public reporting is being used to encourage patient awareness and giving healthcare consumers information to make decisions regarding healthcare providers. Lower-performing hospitals, already receiving reductions in payments from CMS, could see even further declines in revenue as patients and/or insurers choose hospitals with reported high performance.

Current Study

Mortality in patients with severe sepsis will be analyzed for this project because adherence to sepsis care bundles is now included in the Inpatient Prospective Payment System for CMS effective with October 1, 2015 acute inpatient discharges (21). This particular population has a high in-hospital mortality rate and potential for variation in coding practices. Mortality will not be included in the upcoming changes in the IPPS program, but it is not beyond a reasonable assumption that it will be in the future.

Literature Search

The PubMed database was utilized to identify articles relating to risk-adjusted mortality (RAM) methodology, palliative care coding and its relationship to RAM, and severe sepsis mortality. Articles were limited to those which specifically addressed methodology and the influence of coding, including focused discussions regarding potential confounders, documentation, barriers, and impacts of pay-for-performance initiatives. A date parameter was not set except for one search "((mortality) AND quality) AND reporting". The initial query resulted in 1623 articles; a limit of 10 years reduced it to 1255. The reason for the limitation on this search was because of the major changes in reporting over the past decade.

A total of 1,555 articles were identified via the initial PubMed searches (see appendix A). The following keywords and phrases were used: *benchmarking, CMS, code, coding, documentation, effects, financial incentive, hospital standardized mortality ratio, methodology, metrics, mortality, mortality rate, palliative care, pay-for-performance, public reporting, quality, reporting, risk adjust, risk adjusted mortality, risk adjustment, severe sepsis, and value-based purchasing*. A review of titles yielded a total of 424 articles,126 of which were duplicates, resulting in 298 articles eligible for abstract review. Articles were excluded if the focus was on concurrent risk-assessment (i.e. sole use of clinical data to predict mortality); outcomes assessment software or databases (e.g. Acute Physiology and Chronic Health Evaluation II (APACHE II), American College of Surgeons National Surgical Quality Improvement Program (NSQIP)); electronic medical record (EMR) evaluation; nursing homes; cost analyses or financial outcomes; quality improvement initiatives which include compliance to process-of-care metrics, goals of care, or adherence to guideline; pediatric-focused studies; or risk-adjustment methodologies or evaluations that were not easily generalizable to the United States' healthcare programs or methodologies. One video recording was identified and excluded. A total of 203 articles remained. The year of publication for the articles identified through abstract review ranged from 1988 to 2015.

The identified articles were then read and an additional 15 articles were identified from reviewed articles' references. Articles were further eliminated if they did not involve a focused assessment of the impact of coding or documentation on risk-adjusted mortality. Ultimately, seven articles were included that involved risk-adjusted mortality for a range of conditions; four of these articles involved palliative care coding specifically. (Tables 1-3) Other articles identified through the literature search (not included in the tables) were retained for the wealth of information they provided pertaining to knowledge in the fields of this study's areas of interest.

Figure 1: Literature Review Flowchart

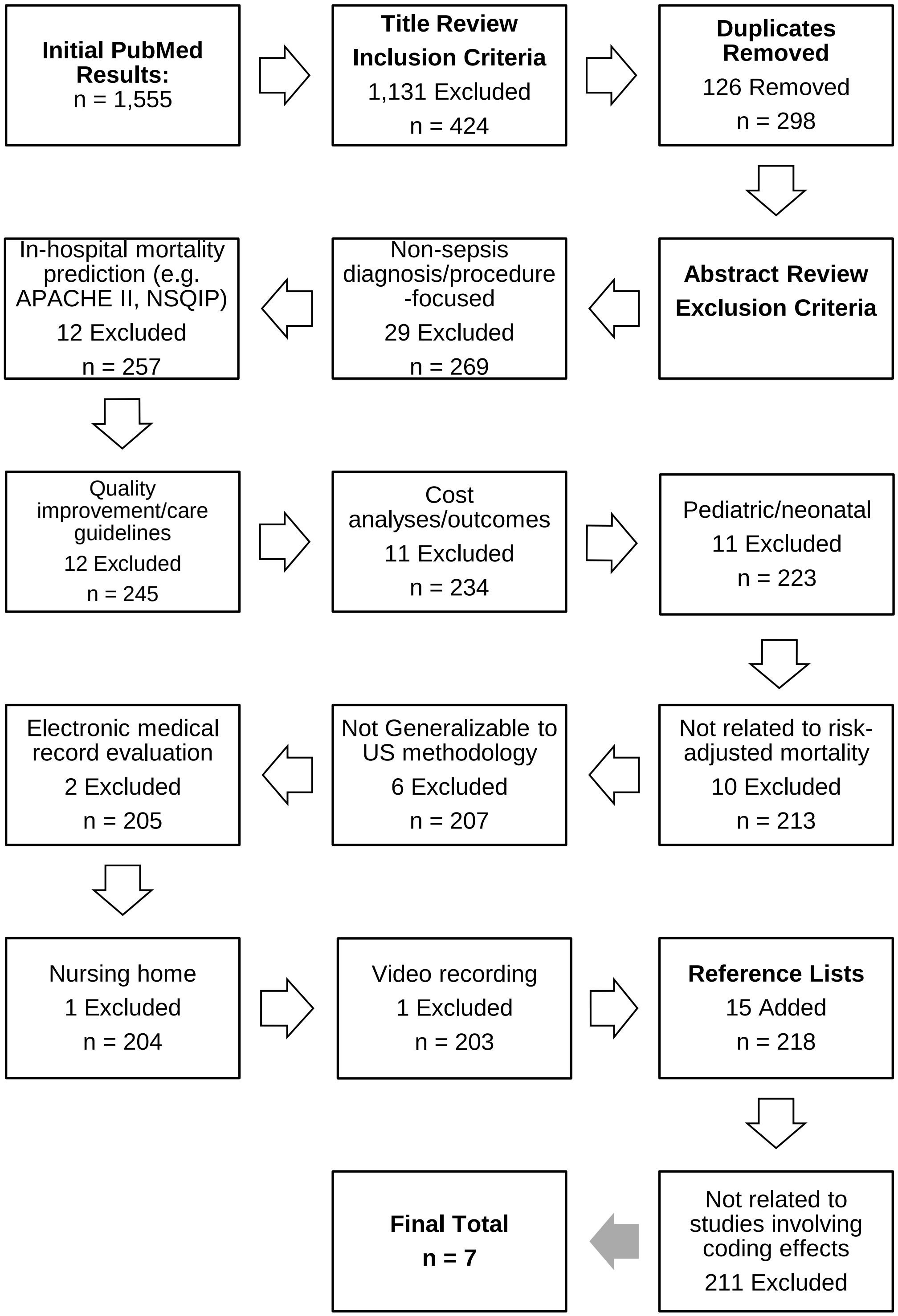


Table 1: Articles relating to coding and documentation impact on Risk-Adjusted Mortality

Author	Objective	Data source	Location	Time period	Population Size	Risk Adjustment Model	Mortality Time	Palliative Care	POA
Dalton, et al (2013)(22)	Evaluate impact of POA on RAM by developing risk-assessment model (POArisk)	Administrative	US	2004-2009	2.6 million	POARisk (author-developed)	In-hospital	no	yes
Bottle, et al (2011)(23)	Evaluate effects of coding on Hospital Standardized Mortality Ratios (HSMR)	Administrative	England	2005-2009	11.3 million	National Health Service-based HSMR	In-hospital 30-day	yes	no
Kroch, et al (2010)(24)	Evaluate the benefits and limitation of using Do-Not-Resuscitate (DNR) and Palliative Care Orders on risk-adjusted mortality.	Administrative; Medical record abstraction	US	11/1/05 to 10/30/06	9197	CareScience	In-hospital	yes	no
Chong, et al (2012)(8)	Evaluate effect of changes of Palliative Care usage on HSMR.	Administrative	Canada	4/2004 to 3/2010	12,593,329	Canadian Institute for Health Information	In-hospital	yes	no

Note: POA = Present on Admission

Table 1: Articles relating to coding and documentation impact on Risk-Adjusted Mortality

Author	Objective	Data source	Location	Time period	Population Size	Risk Adjustment Model	Mortality Time	Palliative Care	POA
Klugman, et al (2010)(25)	Analyze the impact of Palliative Care Code (V66.7) on Mortality Indices	Administrative	US	1/2008 to 3/2008	Hip Fractures (94). Overall: Undefined	University HealthSystem Consortium (UHC)	In-hospital	yes	no
Pine, et al (2009)(26)	Analyze impact of enhanced administrative and clinical data on risk-adjusted mortality	Administrative ; Medical record abstraction	US	7/2000 to 6/2003	720,502 5 medical conditions (AMI, PN, CVA, GI Hemorrhage) 3 Surgeries (craniotomy, CABG, AAA repair)	Reference standard model (BEST)--author created	In-hospital	no	yes
Frazee, et al(27) (2015)	Analyze the effect of concurrent chart review by trauma/acute care surgeons to improve physician documentation on severity of illness (SOI), case mix index (CMI), and risk of mortality (ROM), length of stay (LOS), and Injury Severity Score (ISS)	Chart Abstraction	US	2009 to 2012	2735	unlisted	n/a	no	no

Note: AMI = Acute Myocardial Infarction, PN = pneumonia, CVA = Cerebrovascular Accident, GI = Gastrointestinal,
AAA = abdominal aortic repair, CABG = Coronary Artery, Bypass Graft; POA = Present on Admission*Clinical data include: numeric laboratory values, vital signs, immunocompromise, lethargy, composite clinic scores (i.e. Glasgow Coma Score, etc.)

Table 2: Articles relating to coding and documentation impact on Risk-Adjusted Mortality (Methodology and Results)

Author	Methods	Results
Dalton, et al (2013)(22)	POARisk (POA diagnoses only) compared to created model that include all diagnoses and procedures (AllCodeRisk) and the original Risk Stratification Indices (RSI) model	Better discrimination of outcomes using all codes; however POARisk advised when POA information available.
Bottle, et al (2011)(23)	Logistic regression--9 variations for Sensitivity Analyses including: (1) no palliative care adjustment and (2) no adjustment for Charlson Index (CI) or Palliative Care (PC), and exclusion of zero-day length of stay (discharged alive).	In 56 HSMR models, PC was the most important explanatory variable in one of nine models ("senility and organic mental disorders"); second most important in eight (Cancers (7) and "deficiency and other anaemia". For septicemia, the most important and second most important covariates were age and diagnosis group, respectively. Exclusion of PC adjustment resulted in changes of ≤ 4.9 points for 117 hospitals (80%); 5-9.9 points for 28 hospitals (19%); 10 points for 2 hospitals (1%).These two hospitals had higher than the national average of PC utilization and increased during time period of study (approximately 50% of deaths in the last year of study) Exclusion of PC and CI adjustment and zero-length of stay resulted in changes of ≤ 4.9 points for 95 hospitals (65%); 5-9.9 points for 40 hospitals (27%); 10 points for 12 hospitals (8%).
Kroch, et al (2010)(24)	9 model specifications with observed mortality, Risk Adjusted Mortality (RAM), Do-Not-Resuscitate (DNR) timing, and PC flag as dependent variables. 2 of 9 models assessing impact of PC.	Outcome variation explained by PC (r^2) varied from 0.24 (digestive diseases) to 0.94 (oncology). Shown to be a strong predictor for mortality and covariate for RAM.
Chong, et al (2012)(8)	Binary logistic regression model to predict expected pc cases coded as principal diagnosis (Hospital Standardised Palliative Ratio (HSPR)	Use of palliative care coding has increased over the study time period. HSMR has decreased as HSPR has risen, which may be due to the implementation of public reporting in November 2007. HSMR (Monthly mean) Pre-implementation = 99.60 (98.22-100.99); post-implementation = 91.06 (89.84 - 92.28) HSPR (monthly mean): Pre-implementation 100.72 (99.20 to 102.25); post-implementation = 149.56 (145.32 - 153.79)
Klugman, et al (2010)(25)	Observational study	Palliative care coding rate increased from 0.67% (CY 2007) to 6.52% by Quarter 2 2008. Mortality index (Observed/Expected) decreased from 1.15 to 0.85
Pine, et al (2009)(26)	Comparison of models: Base model (administrative; POA conditions only); 3 POA models with varying levels of coding completeness; 2 laboratory (numerical) models with POA with varying levels of coding completeness.	Failure to risk-adjust resulted in misclassifying a hospital as an outlier at a rate of 4.1%. POA models without lab data reduced rate by 59-69%; POA models with laboratory values reduced the rate by 83%.
Frazee, et al (2015)(27)	Retrospective observational study	From 2009 to 2012 mean SOI increase from 2.31 to 2.71; ROM from 1.90 to 2.12; CMI from 2.11 to 2.39. All results were significant ($p < 0.05$)

Note: AMI = Acute Myocardial Infarction, PN = pneumonia, CVA = Cerebrovascular Accident, GI = Gastrointestinal, AAA = abdominal aortic repair, CABG = Coronary Artery, Bypass Graft; POA = Present on Admission*Clinical data include: numeric laboratory values, vital signs, immunocompromise, lethargy, composite clinic scores (i.e. Glasgow Coma Score, etc.)

Table 3: Articles relating to coding and documentation impact on Risk-Adjusted Mortality (Covariates)

Author	Dalton, et al (2013)(22-24)	Bottle, et al (2011)(23)	Kroch, et al (2010)(24)	Chong, et al (2012)(8)	Klugman, et al (2010)(25)	Pine, et al (2009)(26)	Frazee, et al (2015)(27)
Age	x		x	x	x	x	
Gender	x		x		x	x	
ICD Version (9 vs. 10)	9	10	9	10	9	9	9
Diagnosis-Related Groups	x	x	x		x	x	
Principal Diagnosis	x	x	x		x	x	
Secondary Diagnoses	x	x	x			x	
Principal Procedure	x	x	x	count	count	x	
Secondary Procedures	x	x	x	count	count	x	
Admit Date		x	chart review				
Discharge Date			chart review				
Length of Stay				x			
Admit Type (e.g. emergent)		x	x				
Comorbidity Index		Charlson	Author-developed	Charlson			
Palliative Care flag		x	chart review	x			
Unplanned admits (previous year)		x					
Admit Source		x			x		
Ethnicity/race		x	x				
Do Not Resuscitate (DNR) flag			chart review				
DNR date			chart review; database				
Income			x				
Distance traveled			x				
Cancer status			x	metastatic (binary)			
Admit Source			x				
Payer type			x				
Facility type			x				
Medical vs. Surgical				binary			
Other		Carstairs deprivation quintile				Clinical data (POA)	

Note: AMI = Acute Myocardial Infarction, PN = pneumonia, CVA = Cerebrovascular Accident, GI = Gastrointestinal, AAA = abdominal aortic repair, CABG = Coronary Artery, Bypass Graft; POA = Present on Admission*Clinical data include: numeric laboratory values, vital signs, immunocompromise, lethargy, composite clinic scores (i.e. Glasgow Coma Score, etc.)

Mortality Rates

There are multiple methods utilized in the comparison of mortality rates across hospitals. A common method is to divide a hospitals actual ("observed") mortality rate (number of in-hospital deaths divided by the total number of discharges) by an expected mortality rate. The expected mortality rate is based on patient risk factors and calculated using logistic regression models. The result of this ratio (Observed/Expected (O/E)) is then multiplied by the crude national mortality rate; this allows hospitals to compare their performance to a national rate. The limitation of this, however, is that hospitals with low volumes can have wide variation in rates (28).

CMS, on the other hand, uses hierarchical logistic regression models to estimate risk-standardized mortality ratios (RSMRs) for the five conditions of interest (Acute Myocardial Infarction, Heart Failure, Pneumonia, Stroke and COPD) in Medicare Fee-For-Service and Veterans' Administration beneficiaries (5). A model is constructed adjusting for patient and hospital-specific effects which allows for hospitals with low volumes to be included and moving their rates closer to the national average. The RSMR is the ratio comparing predicted (based on risk factors collected throughout the continuum of care (i.e. prior to admission through 30-days post discharge) and hospital-specific effect). This result is then divided by the expected deaths (the number of deaths based on patient risk factors and the average of all (national) hospital-specific effects. This ratio (Predicted:Expected (P:E)) is then multiplied by the crude national rate (5, 28).

The hospitals are rated as “No Different”, “Worse”, or “Better” than the U.S. national rate, depending on whether their corresponding rates fall within or outside of the 95% interval estimate (5). These results are placed on CMS’ Hospital Compare website with the intention not to compare hospitals to one another, but rather to an observed national rate. The Value-Based Purchasing program goes one step further and compares a hospitals’ performance to their own so that the mortality rates (for AMI, HF and PN) are looked at and scored in two ways—how the hospital compares with other hospitals and how the hospital compares with itself during a pre-defined baseline period; these scores are based on performance (compared to other hospitals) and improvement (compared to baseline scores) (3, 4).

CMS utilizes administrative and national data, and has access to other sources (outpatient and registration), that hospitals do not. Hospitals are unable to replicate the CMS methodology, and tracking of 30-day mortality is difficult for patients who die outside of the hospital. Hospitals are limited to measuring in-hospital mortality and utilizing a common methodology as described above, or, in the case of Vizient, Inc., a straightforward O/E, where the expected mortality is calculated from models created using patient data gathered from member hospitals. The use of administrative data has limitations because it is dependent on provider documentation and hospital coding quality. Shahian (2012) listed the following important limitations of administrative data:

- Not designed to profile performance
- Case misclassification
- Difficulty in distinguishing complications from comorbidities
- Absence of critical clinical variables
- Coding inaccuracy
- Failure to code chronic conditions or secondary diagnoses
- Non-standardized endpoints (30-day vs. in-hospital mortality)
- Restrictions to selected subpopulations (14)

These limitations make it imperative to have accurate coding to be able to accurately assess mortality rates.

Palliative Care (V66.7) Code

In a recent study conducted by the RAND corporation, the authors cite the need for research into the question of whether hospitals might be "gaming the system" via their coding practices (6).

One particular coding practice has been discussed—the use of the Palliative Care code (V66.7) and its influence, if any, on risk-adjusted mortality (1, 29, 30). Vizient, Inc., utilizes claims-based data to provide quality metrics and benchmarking data to participating academic medical centers (AMCs) such as mortality indices. The mortality index is the observed (actual) mortality rate (%) divided by the average expected mortality of patients within each hospital. The expected mortality is calculated using member data. Member hospitals are able to use the CDB/RM to monitor outcomes and compare their performance to other participating member hospitals.

In a personal communication with an individual in the UHC Clinical Data and Informatics department, the author of one study was informed that when comparing two patients with the same DRG, demographics, diagnoses codes, and procedure codes, the person who had the V66.7 code would have a higher risk of mortality, or expected mortality rate (1). It needs to be noted that the use of the V66.7 code is not exclusive to services rendered by a Palliative Care team or specialists; this code can be applied when documentation exists stating that patient is receiving hospice care, comfort measures or other terminology that indicates end-of-life care (31).

A brief query into the Vizient, Inc., Clinical Database/Resource Manager (CDB/RM) shows a nearly seven-fold increase in the use of this code between 2010 and 2013. The aggregate mortality index of participating UHC hospitals has decreased in this same time frame. It is unknown what the relationship is, if any, between the use of the palliative care code and the decrease in the aggregate mortality index is.

Severe Sepsis and Septic Shock

Approximately one quarter of in-hospital deaths are due to severe sepsis. The International Guidelines for Management of Severe Sepsis and Septic Shock 2012 as part of the "Surviving Sepsis Campaign", defines severe sepsis as "acute organ dysfunction secondary to documented or suspected infection" (32). The Guidelines define septic shock as "severe sepsis plus hypotension not reversed with fluid resuscitation" (32). A general query of hospitals in the Vizient, Inc. CDB/RM for the calendar year 2014 resulted in approximately 107,000 cases of patients with a diagnosis of severe sepsis (ICD-9-CM 995.92) and an observed mortality of 27%. The Surviving Sepsis Campaign, begun in 2002, is a national collaborative to establish evidence-based guidelines to identify and manage severe sepsis and septic shock and decrease mortality. Analyses of the effect of resuscitation and management bundles created to facilitate these goals have shown a correlation between high compliance to the bundles and decreases in mortality (33). CMS also recognized the problem of this condition and has added sepsis-related process of care measures to the list of required reported measures for their Inpatient Quality Reporting (IQR) program commencing with October 2015 discharges. Sepsis-related mortality, however, has not been included in CMS publically-reported mortality measures.

Severe sepsis does conform to the suggested criteria for identifying conditions with which to evaluate mortality—adequate number of patients and deaths, a relationship between quality and mortality as witnessed by the Surviving Sepsis Campaign, few legitimate exclusions, and adequate clinical or administrative data. Severe sepsis is also a medical condition, which is a stronger category for evaluating performance than surgical conditions (34).

Coding practices may also be an issue for this condition. Patients can be coded with an infection and acute organ dysfunction (15, 18) or they can have a code for septicemia, bacteremia, or fungemia plus acute organ dysfunction (17, 18). They can be coded in a straightforward manner with severe sepsis (995.92) and/or septic shock (785.52)--codes that were introduced in 2002 and 2003--or a combination of all of the above (10, 18, 19, 35). There is no “gold standard” for coding severe sepsis, and in a study conducted by Gaieski, et al (2013), it was found that only 51.4% to 56.6% of patients with a code for septic shock had a corresponding code for severe sepsis (10).

Severe sepsis-related mortality in hospitals is not publically-reported at the time of this study which may mitigate at least some of the bias created by the Hawthorne Effect. This type of bias is suspected in mortality rates for AMI, heart failure and pneumonia. Financial implications attached to these publically-reported outcomes, and the attention placed on these areas, could divert attention from other conditions not subject to the incentives or penalties. Severe sepsis, while being the subject of a national collaborative, does not yet carry the same financial implications. Participating hospitals in the Surviving Sepsis

Campaign are focused on improving processes and mortality, but the data collected and analyzed are from clinical data entered by the hospitals, separate from administrative data (33). The focus on hospital coding for this condition, even with this collaborative may not be as intense as in the other publically-reported and VBP conditions. The high in-hospital mortality rates associated with severe sepsis, the large number of patients, and the issues with coding, make this condition a promising one with which to analyze coding practices. It will allow for some sensitivity analyses or correlations between the use of the palliative care code and the way in which the cases are being coded for severe sepsis.

CHAPTER THREE: METHODS

Introduction to Chapter

This chapter will discuss the methodology utilized to compare high- and low-performing hospitals in the following areas—use of palliative care coding; coding for severe sepsis; and MS-DRG assignment. Description of the methodology will include the data source; the identification of the study population; and the statistical tests used to address each aim.

Data Source

Data were obtained from the Vizient™ (formerly University HealthSystem Consortium (UHC)) Clinical Database/Resource Manager (CBD/RM) by permission of Vizient. (All rights reserved.) Vizient™ is a "member-driven, healthcare performance improvement company" (36). The CDB includes administrative data from member academic medical centers and their affiliated hospitals plus community hospitals (37). The data within the CDB/RM are available to members only; University of New Mexico Health Sciences Center/University of New Mexico Hospital are current members. A study correlating data obtained from UHC and University of Cincinnati demonstrated that UHC was a reliable proxy for hospital medical records which is important when conducting analyses on patient outcomes when the latter are unavailable for use (38). The focus of this study is on variation in coding among hospitals, but it is necessary to utilize a database with demonstrated reliability and a robust data validation process prior to finalizing data release.

Study Population

Case profiles were downloaded from the CDB/RM for Calendar Year 2014; this year was chosen because it was the most recent with a complete year utilizing the same ICD version (ICD-9-CM) at the time of this study; ICD-10-CM commenced with October 1, 2015 discharges. The patients in this database come from hospitals across the United States, and as such, are demographically diverse in terms of race, ethnicity, socioeconomic status, and geographic location.

Inclusion/Exclusion Criteria—Patient Level

Patients were included in the study if they were aged 18 years or older and had any diagnosis (principal or secondary) or combination of diagnoses indicating severe sepsis that was present-on-admission (POA) (39, 40). The ICD-9-CM codes used to identify these patients followed criteria suggested by Wang and Angus (15, 41). There are multiple ways to capture severe sepsis in the ICD-9-CM coding structure, therefore the coding parameters were as follows:

1) Any diagnosis of bacterial or fungal infection (Appendix B) with a corresponding code of organ dysfunction (Appendix C) including

respiratory failure (518.8), apnea (786.03), and respiratory arrest (799.1) (39).

2.) Any diagnosis of severe sepsis (995.92) (39).

3). A diagnosis of sepsis (995.91) without a corresponding diagnosis for organ dysfunction (Appendix C) were excluded, in accordance with the definition of severe sepsis (39).

Please refer to Appendices B and C for the list of diagnosis codes, adapted from Angus et al (2001) (15).

Patients were excluded if they were transferred from, or discharged to, another acute hospital, or if they were admitted from hospice or left the hospital against medical advice (LAMA). Hospitals are evaluated on mortality outcomes which are used as a quality-of-care metric; including these patients makes it difficult to evaluate hospital performance when the continuum of care spans more than one acute care hospital (hospital transfers); the patient is admitted when escalation of care is not desired (hospice); or the patient has not been compliant with hospital advice (LAMA). These exclusions align with CMS methodology for their mortality metrics (5). Patients were also excluded if they had a flag for the following: bad data (e.g. null values in significant fields such as LOS, MS-DRG; discharge date precedes admission date), exempt unit (e.g. psychiatric unit within the hospital), hospice, or medical tourism (international principal or secondary payer). Medical tourism was excluded due to the potential effect of unknown confounders that it may present.

Patients with multiple inpatient admissions (unique encounter numbers, readmissions) were not excluded. Readmissions are a quality metric followed by CMS and have the potential to affect mortality ratios when calculating observed mortality, patients can contribute multiple admissions to the denominator but only once to the numerator (42).

Inclusion/Exclusion Criteria—Hospital Level

Data submitted to Vizient™ must meet error thresholds prior to inclusion into the CDB/RM; however, hospitals may have data missing for certain time periods. Only hospitals with data for all twelve months of Calendar Year 2014 were included in the analyses. All patients and hospitals were de-identified prior to download of patient-level data.

Hospitals were also excluded from analyses if there were less than 5 predicted deaths for the study time period; this helps to mitigate dramatic changes in the mortality index (O/E) when the expected mortality (denominator) is small (2, 41).

Software

Microsoft Access and Excel were used to link data files and clean data. Analyses were conducted utilizing Stata IC14 (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP).

Hospital Categorization

Once inclusion and exclusion criteria were applied, hospital mortality indices were calculated by dividing the hospital's observed mortality (deaths/discharges) by their average expected mortality (calculated on a per-patient basis by Vizient, Inc., using logistic regression models incorporating significant risk variables such as patient diagnoses, procedures and demographics). Hospitals were then ranked by their mortality index (Observed/Expected) and divided into quartiles. Quartile 1 includes those hospitals with the lowest Mortality Indices ("high performers") and those in Quartile 4 have the highest Mortality Indices ("low performers") (43). Initial analyses for this study were comparisons between these two performance groups; further analyses were conducted utilizing all four quartiles order to identify any patterns or trends that may be present in the data and otherwise missed. Chi-square tests and t-tests were used to analyze differences in patient characteristics between the quartiles.

Patient Characteristics/Variables

Patient characteristics were compared, in particular, between Quartile 1 and Quartile 4. The characteristics fell into three categories--demographics; inpatient stay and outcomes; and finally coding characteristics.

Demographics

Variables examined included patient gender; age; age group according to CMS categories; race; ethnicity (Hispanic origin); and primary payer (insurance) source. Missing data and data reported as "unavailable" or "declined to answer" were also compared, as this could be indicative of process or documentation issues that could be relevant.

Inpatient stay and outcomes

Admission source was compared to determine the proportion of patients who were admitted from a non-facility point of origin (e.g. home); referred from a clinic or a physician; transferred from a skilled nursing facility (SNF) or Intermediate Care Facility (ICF); transferred from another facility such as a rehabilitation center; or were transferred from a court or law-enforcement type facility (e.g. correctional facility). Data were included to compare those who were brought into the hospital through the Emergency Department, identified by an "ED flag" in the administrative data, and subsequently admitted. These variables can be indicators of severity of illness.

Rates of discharge to different venues were compared. Patients were categorized with the following discharge dispositions: expired (in-hospital death); home; home with home health care; hospice (home or medical facility); a Long-Term Care Hospital (LCTH, non-acute); other medical, non-acute facility; other non-medical facility (i.e. custodial care, correctional facility); or a skilled nursing facility or rehabilitation. The proportion of deaths that occurred within 48 hours of admission ("Early Death") was calculated and compared.

The proportion of patients whose admission included care in an intensive care unit (ICU stay); the average length of stay and the expected mortality (based on the Vizient, Inc., risk models) were calculated and compared. The proportion of patient visits which were 30-day readmissions (the patient was admitted within 30 days of a previous discharge) was not calculated or compared, but 30-day readmissions as a binary variable (yes/no) were used in the logistic regression model for determining differences in palliative care code usage.

Coding Characteristics

All-Patient Refined Diagnosis Related Groups (APR-DRG) provided information for the following variables—Weight (which is a calculation of severity based on coding), severity of illness (SOI), and risk of mortality (ROM) (44). The APR-DRG SOI and ROM at admission were also compared. There are four levels in each of these indicators—Minor, Moderate, Major and Extreme.

Medicare-Severity Diagnosis Related Group (MS-DRG) is assigned based upon documentation and coding completed upon discharge of the patient. This study focused on the MS-DRG type (Medical versus Surgical) and weight level, in particular high-weighted MS-DRGs ("High MS-DRG").

Relative Expected Mortality (REM) is a category assigned by Vizient, Inc., which indicates the relative distance between the expected mortality of a patient and the mortality of patients upon which the risk model was based. Patients are categorized as Well Below, Below, Equal To, Above and Well Above.

Analysis Plan

The analysis plan for the specific aims of this study are described below.

Specific Aim 1: To compare usage of the ICD-9-CM Code V66.7 between hospitals who have better-than-expected mortality rates ("high performers") and those who have worse-than-expected in-hospital mortality rates ("low performers") in patients coded with severe sepsis and/or septic shock.

Utilization of ICD-9-CM code V66.7 was compared between hospitals in the 1st and 4th Quartiles, based upon mortality indices. The initial analyses were conducted using a chi-square test of proportions. Logistic regression was then done to calculate odds ratios for the presence of V66.7. Candidate independent variables were included in the model and examined for significant effect in the model ($p < 0.05$). The model was then evaluated for appropriate specification utilizing the Homer and Lemeshow goodness-of-fit test and the linktest function in STATAIC14 (45, 46). The independent variables used are listed in Table 4.

Table 4: Independent Variables for Logistic Regression (Palliative Care, binomial dependent variable)

Independent Variable	Type
Quartile	Categorical
Gender	Dichotomous
Race	Categorical
Admission Source	Categorical
Discharge Disposition	Categorical
Principal Payer Type	Categorical
Length of Stay	Continuous
Age Group	Categorical
Intensive Care Unit	Binary
All Patient Refined Diagnosis Related Group (APR-DRG) Weight	Continuous
Medicare Severity Diagnosis Related Group (MS-DRG) Type (Medical vs. Surgical)	Dichotomous
Admitted from Emergency Department (ED)	Dichotomous
Ethnicity (Hispanic)	Binary
Readmission (discharged within 30 days prior to current admission)	Binary
Sepsis Type (Severe Sepsis with or without Septic Shock)	Dichotomous

Specific Aim 2: To further examine variations in coding between low- and high-performing hospitals by determining the manner in which severe sepsis is coded and its association with utilization of the palliative care ICD-9 codes.

Patient level data were downloaded and cleaned prior to any analysis in order to identify hospitals to be included. Patients had to have either a diagnoses code for severe sepsis (995.92) or a combination of codes for an infection and organ dysfunction (See Appendices B and C). A comparison was also done of the occurrence of the code for septic shock without a corresponding code for severe sepsis (an indicator of a coding error) (47).

Patients were categorized into the following groups: infection plus organ dysfunction; severe sepsis without septic shock; severe sepsis with septic shock; and septic shock without a corresponding code for severe sepsis. A two-sample test of proportions was done to compare the lowest and highest quartiles.

Specific Aim 3: To compare the level of the Medicare-Severity Diagnosis Related Groups (MS-DRGs) assigned between low- and high-performing hospitals.

MS-DRG was examined in three ways. MS-DRG weight was compared between the two groups utilizing Welch's t-test for unequal variances (48). MS-DRG type (surgical vs. medical)was compared utilizing a two-sample test of proportions. Logistic regression was utilized to compare level of MS-DRG. MS-DRGs can be singlets, doublets or triplets. In the case of doublets or triplets, the lowest numbered MS-DRG in the series has the highest MS-DRG weight (i.e. the first of two in a doublet or the first of three in a triplet) (49). A binary variable, "Highest MS-DRG" (yes/no) was created and utilized as the dependent variable for the regression analyses. (See Table 5 for examples of each category.)

Table 5: Example of MS-DRG Singlets, Doublets, and Triplets (Adapted from FY 2015 CMS Table)

MS-DRG	Category	Title	Weight	Type	Highest?
870	Singlet	Septicemia or Severe Sepsis with Mechanical Ventilation > 96 hours	5.8698	Medical	Yes (1)
871	Doublet	Septicemia or Severe Sepsis without Mechanical Ventilation with MCC	1.8072	Medical	Yes (1)
872		Septicemia or Severe Sepsis without Mechanical Ventilation without MCC	1.0528	Medical	No (0)
853	Triplet	Infectious and Parasitic Disease with Operating Room Procedure with MCC	5.2068	Surgical	Yes (1)
854		Infectious and Parasitic Disease with Operating Room Procedure with CC	2.3877	Surgical	No (0)
855		Infectious and Parasitic Disease with Operating Room Procedure without CC or MCC	1.7057	Surgical	No (0)

Note: MCC = Major Complications or Comorbidities; CC = Complications or Comorbidities

Candidate independent variables were included in the model and examined for significant effect in the model ($p < 0.05$). (The independent variables used are listed in Table 6.) The model was then evaluated for appropriate specification utilizing the Homer and Lemeshow goodness-of-fit test and the linktest function in Stata IC14 (45, 46).

Table 6: Independent Variables for Logistic Regression (Highest MS-DRG Level, binomial dependent variable)

Independent Variable	Type
Quartile	Categorical
Admission Source	Categorical
Discharge Disposition	Categorical
Principal Payer Type	Categorical
Age Group	Categorical
Admit APR Severity of Illness	Categorical
Admit APR Risk of Mortality	Categorical

Sample Size and Power

Sample sizes for the comparison groups were calculated using G*Power 3.1.9.2 software. Calculations were done to achieve power of 80%, 85%, and 90% with an effect estimate (Odds Ratio (OR)) of 1.10, 1.15, and 1.20 when conducting logistic regression analyses; alpha was set to 0.05.

Table 7: Sample Size Calculation

Effect Estimate (OR)	Power	Sample Size	Alpha
1.10	0.80	4259	0.05
	0.85	4952	
	0.90	5897	
1.15	0.80	1984	0.05
	0.85	2306	
	0.90	2745	
1.20	0.80	1168	0.05
	0.85	1357	
	0.90	1615	

Ethical Considerations

This study was submitted to the University of New Mexico Human Research Review Committee/Human Research Protections Office (the University's Institutional Review Board) and granted approval as an exempt study.

CHAPTER FOUR: RESULTS

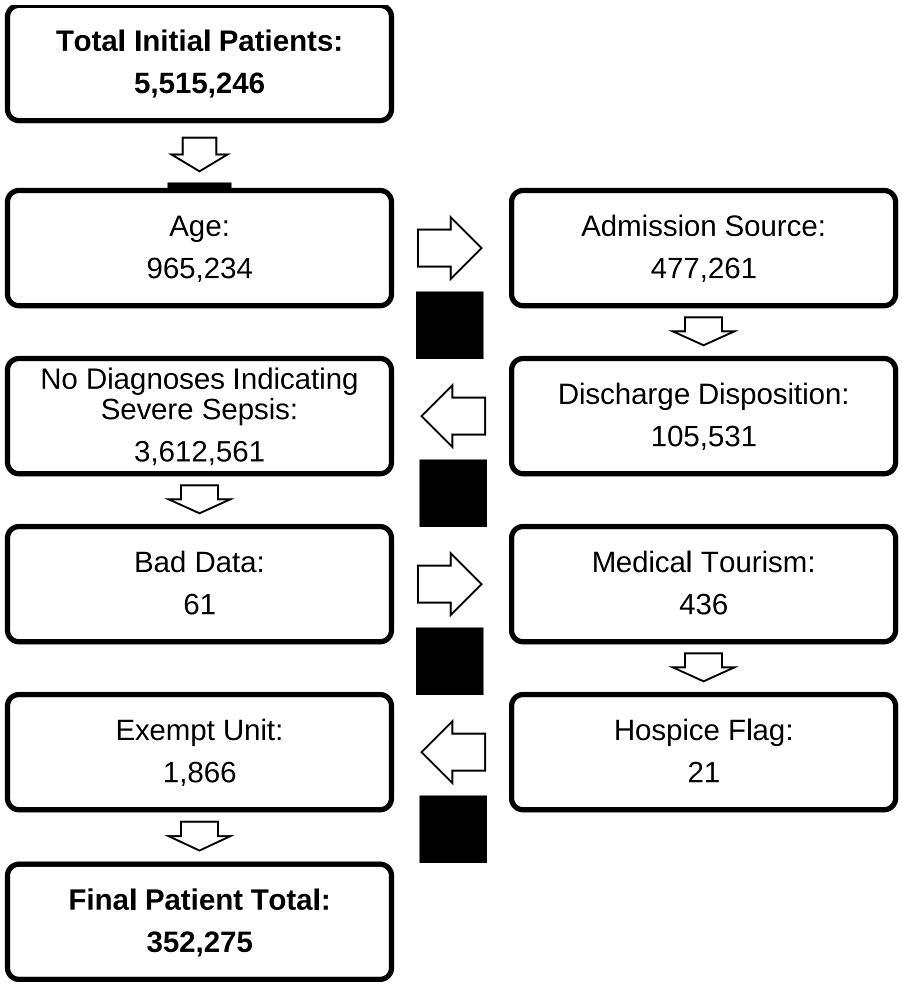
Introduction to Chapter

This chapter focuses on the results of the analyses conducted. It will begin with a discussion of the study population ultimately included in the study followed by a comparison of quartile characteristics. The chapter will conclude with the results of the comparison of palliative care coding usage and MS-DRG level assignment between high- and low-performing hospitals.

Patient and Hospital Inclusion

Patient-level data were downloaded from the Vizient, Inc., Clinical Database/Resource Manager (50). Over 5 million encounters were downloaded to which inclusion and exclusion criteria were applied. See Figure 2 for results of application of exclusion criteria.

Figure 2: Flowchart: Initial Cohort and Patients Lost to Exclusion Criteria



A total of 352,275 patient encounters remained after applying inclusion and exclusion criteria. Hospitals were then checked for twelve months of data present for Calendar Year 2014. A total of 12 hospitals were excluded which resulted in the exclusion of 1,928 patient encounters; 350,347 encounters remained. Hospitals were then evaluated to identify those with less than 5 predicted deaths for the year. Eight hospitals, and 608 patient encounters, were excluded. The final total for the study was 249 hospitals and 349,739 patient encounters.

Quartile Characteristics—Full population

Table 8 displays the characteristics of the hospitals by quartile. Hospitals were ranked by their mortality index (Observed/Expected) and divided into quartiles. Quartile 1 hospitals, the “high performers”, included 62 hospitals and 91,721 patient encounters. The mortality indices of these hospitals ranged from 0.33 to 0.80 (mean = 0.67; SD = 0.10). Quartile 4 hospitals, the “low performers”, included 62 hospitals and 67,294 patient encounters. The mortality indices of hospitals in Quartile 4 ranged from 1.11 to 6.45 (mean = 1.45; SD = 0.69).

Continuous variables were analyzed using t-tests; categorical variables were analyzed using chi-square tests. The Average Length of Stay (ALOS) was 7.71 days for Quartile 1 hospitals and 9.78 days for Quartile 4 ($p < 0.0001$). The expected mortality was 8.51% for Quartile 1 and 8.70% for Quartile 4 ($p < 0.0001$); the mortality indices were 0.68 and 1.31, respectively. There were statistically significant differences in most categories (p-values < 0.0001). Of note, Quartile 4 hospitals had a statistically higher proportion of patients in underrepresented groups: Black 24.57% vs. 22.45%; Asian 3.48% vs. 1.23%; and Other, 13.33% vs. 4.73%. The “other” category could include those who did not wish to choose, did not know, or who identify as “Hispanic” and none of the other categories. The proportion of patients who identify as “Hispanic” in Quartile 4 was double that of Quartile 1 (8.23% vs. 3.87%).

Quartile 4 had higher proportions of patients who were admitted from a Non-Facility Point of Origin (87.77% vs. 81.64%) and court or law enforcement (0.26% vs. 0.17%), although the number of discharges in the latter category were minimal. A higher proportion of patients were admitted from the Emergency Department was greater (82.71% vs. 67.83%), however, Quartile 4 hospitals had a higher rate of missing data related to this metric (18.61% vs. 8.70%).

The differences in the discharge disposition of patients were not statistically significant for the proportion of patients who were discharged home ($p = 0.36$), to home health ($p = 0.92$) and to a non-medical facility not elsewhere defined ($p = 0.05$). There were statistically significant differences in the discharge dispositions most associated with palliative care. Quartile 1 had a lower percentage of patients who died in-hospital (5.80% vs.11.36%, $p <0.0001$) and a higher proportion who were discharged to hospice care (5.77% vs. 3.41%, $p <0.0001$). The mortality rates increased, and hospice rates decreased, as the level of quartile increased (lower quartile is better).

There were statistically significant differences in the proportion of patients who were covered under the various payer types (p values < 0.05). Quartile 1 hospitals had a notably higher percentage of patients covered by Medicare (66.63% vs. 60.82%) and commercial insurance (16.42% vs. 15.08%) than

Quartile 4 hospitals. Quartile 4 hospitals had a higher proportion of Medicaid recipients (16.58% vs. 12.47%); the middle quartiles also had higher proportions of Medicaid recipients and lower proportions of Medicare recipients than Quartile 1 hospitals.

Characteristics that are related to documentation and coding—APR-DRG and MS-DRG weights; Admit APR ROM; and SOI (except for category "Minor" ($p = 0.2714$)); and MS-DRG type ($p < 0.0001$) were significantly different. Non-significant differences were seen in the Relative Expected Mortality category. Relative Expected Mortality was different in the categories of "Below" and "Well Above". Quartile 4 was higher in the "Below" category ($p = 0.0002$) and lower in the "Well Above" category ($p = 0.0012$); which is consistent with the mortality indices of both quartiles, although a similar pattern didn't occur with Quartiles 3 and 4.

<u>Palliative Care Code Usage—Full Population: Quartile 1 vs. Quartile 4</u>

Specific Aim 1 was to compare the usage of the ICD-9-CM code for Palliative Care (V66.7) between Quartile 1 and Quartile 4 hospitals. Quartile 1 hospitals discharged a higher proportion of patients to hospice (home or medical facility), Long Term Care Hospitals (LTCH), Skilled Nursing Facilities (SNF) and other medical facilities. These differences could reflect differences in programs such as Care Management, or the focus of this study, Palliative Care, and how they facilitate patient discharges and transfers. The hypothesis was that the lower performing hospitals, those in Quartile 4, would have lower V66.7 usage. In this population, the reverse was shown--usage of the palliative care code was higher in Quartile 4 hospitals (9.55% vs. 8.39%); although when comparing the proportion of in-hospital deaths, Quartile 1 hospitals have higher usage (51.55% vs. 46.58%). A similar result is seen when looking at the presence of the V66.7 code for patients discharged to hospice care (61.53% vs. 57.05%). All results were significant at the ($\alpha = 0.05$) level.

Severe Sepsis Coding—Full Population: Quartile 1 vs. Quartile 4

Specific Aim 2 was to compare the coding of severe sepsis. Four categories were created for comparison: infection with organ dysfunction, severe sepsis without shock, severe sepsis with shock, and septic shock alone (no corresponding code for severe sepsis). The hypothesis was that there would be a significant difference between high- and low-performing hospitals in the way in which severe sepsis was coded; low-performing hospitals would have a significantly higher rate of patients who were coded with infection and organ dysfunction or septic shock without a corresponding code for severe sepsis (a coding error). There was a significant difference in the proportion of patients who had severe sepsis with and without septic shock (ICD-9-CM 995.92 and 995.92 plus 785.52).

There was not, however, a significant difference in the patients coded with infection plus organ dysfunction ($p = 0.50$) or septic shock without a corresponding code for severe sepsis (p = 0.69). One of the limitations of using administrative data is that there are no dates attached to diagnosis codes indicating date of onset. Even though the diagnosis codes utilized in this study were flagged as “Present on Admission” (POA), it is not possible to determine whether the diagnosis for infection and organ dysfunction were contemporaneous, or if the organ dysfunction preceded the infection. Due to the lack of statistical significance of the coding differences, all analyses for specific aims 1 and 3 were conducted utilizing only those patients with codes for severe sepsis (995.92) or severe sepsis with septic shock (995.92 and 785.52). Cases that had code 785.52 in the absence of 995.92 were also eliminated as this represents an error in coding (47). Reducing the population in this way eliminates potential confounding that could result from the inclusion of patients who had only a code for infection and organ dysfunction. (See Table 8 for details).

Table 8: Quartile Characteristics—Full Population

	Quartile 1		Quartile 2		Quartile 3		Quartile 4		
Variable	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Q1 vs. Q4 p-value**
Hospitals	62		62		63		62		
Mortality Index (Ratio)	0.68		0.89		1.03		1.31		
Discharges	91721		92568		98156		67294		
Female	47754	52.06	46341	50.06	49341	50.27	33483	49.76	<0.0001
Age (mean) *(SD)* *[median]*	*65.14* *(15.73)* *[67]*		*65.10* *(15.75)* *[67]*		*62.37* *(16.12)* *[64]*		*64.53* *(16.03)* *[66]*		<0.0001
Age Group									
18-44 years	9709	10.59	9851	10.64	13620	13.88	7785	11.57	<0.0001
45 to 65 years	31174	33.99	31151	33.65	37488	38.19	23455	34.85	0.0003
66 to 84 years	41681	45.44	42400	45.80	39898	40.65	29384	43.67	<0.0001
85 years and older	9157	9.98	9166	9.90	7150	7.28	6670	9.91	0.64
Race									
White	63814	69.57	67589	73.02	58196	59.29	37117	55.16	<0.0001
Black	20589	22.45	15688	16.95	26907	27.41	16534	24.57	<0.0001
Asian	1124	1.23	1966	2.12	2104	2.14	2339	3.48	<0.0001
Other	4339	4.73	6241	6.74	7844	7.99	8971	13.33	<0.0001
Unknown/unavail/declined	1855	2.02	1084	1.17	3105	3.16	2333	3.47	<0.0001
Ethnicity									
Hispanic	3549	3.87	5574	6.02	9603	9.78	5536	8.23	<0.0001
Not Hispanic	70867	77.26	59951	64.76	61500	62.66	34018	50.55	<0.0001
Unknown/Unavail/Declined/Missing	17305	18.87	27043	29.21	27053	27.56	27740	41.22	<0.0001
Admission Source									
Non-facility Point of Origin	74880	81.64	75938	82.03	83880	85.46	59065	87.77	<0.0001
Clinic/Physician referral	10417	11.36	10441	11.28	7803	7.95	4011	5.96	<0.0001
Transfer from SNF or ICF	5079	5.54	4551	4.92	5059	5.15	3291	4.89	0.0009
Transfer from another facility	1192	1.30	1379	1.49	1317	1.34	750	1.11	<0.0001
Court/Law enforcement	153	0.17	259	0.28	97	0.10	177	0.26	<0.0001

Technical Note: *Continuous variables analyzed using t-tests*; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.

Table 8: Quartile Characteristics—Full Population (Continued)

Variable	Quartile 1 Count	Quartile 1 %	Quartile 2 Count	Quartile 2 %	Quartile 3 Count	Quartile 3 %	Quartile 4 Count	Quartile 4 %	Q1 vs. Q4 p-value*
Admitted through Emergency Department									
No	7877	8.59	8693	9.39	10473	10.67	9126	13.56	<0.0001
Yes	75860	82.71	62142	67.13	69198	70.50	45644	67.83	<0.0001
MIssing	7984	8.70	21733	23.48	18485	18.83	12524	18.61	<0.0001
Discharge Disposition									
Expired (Observed Mortality)	5319	5.80	7473	8.07	9075	9.25	7643	11.36	<0.0001
Home	37834	41.25	35403	38.25	43233	44.05	27603	41.02	0.36
Home health	17489	19.07	18887	20.40	18119	18.46	12844	19.09	0.92
Hospice (home or medical facility)	5289	5.77	4141	4.47	3687	3.76	2298	3.41	<0.0001
Long-Term Care Hospital (LCTH)	2350	2.56	2236	2.42	2012	2.05	1291	1.92	<0.0001
Other medical facility	436	0.48	475	0.51	397	0.40	212	0.32	<0.0001
Other non-medical facility	1039	1.13	704	0.76	899	0.92	836	1.24	0.05
Skilled Nursing Facility/Rehabilitation	21965	23.95	23249	25.12	20734	21.12	14567	21.65	<0.0001
Payer Type									
Commercial	15065	16.42	15648	16.90	17063	17.38	10145	15.08	<0.0001
County/State Assistance	457	0.50	571	0.62	659	0.67	573	0.85	<0.0001
Medicaid	11427	12.46	13396	14.47	17736	18.07	11157	16.58	<0.0001
Medicare	61117	66.63	59738	64.53	57279	58.36	40926	60.82	<0.0001
Other	1406	1.53	1694	1.83	2610	2.66	2690	4.00	<0.0001
Uninsured	2249	2.45	1521	1.64	2809	2.86	1803	2.68	0.0045
Average Length of Stay (mean) *(SD)* *[median]*	*7.71* *(8.74)* *[5]*		*8.26* *10.79* *[6]*		*8.96* *12.38* *[6]*		*9.78* *13.80* *[6]*		<0.0001
ICU Stay									
No	60671	66.15	62283	67.28	63924	65.12	45926	68.25	<0.0001
Yes	31050	33.85	29761	32.15	33749	34.38	21368	31.75	<0.0001

Technical Note: *Continuous variables analyzed using t-tests*; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.

APR-DRG: All-Patient Refined Diagnosis-Related Group; MS-DRG: Medicare Severity-Diagnosis Related Group

Table 8: Quartile Characteristics—Full Population (Continued)

	Quartile 1		Quartile 2		Quartile 3		Quartile 4		
Variable	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Q1 vs. Q4 p-value***
Expected Mortality (%)	8.51%		9.07%		8.94%		8.70%		
Relative Expected Mortality									
Well Below	16026	17.47	15855	17.13	18045	18.38	11755	17.47	0.98
Below	39230	42.77	39344	42.50	42629	43.43	29422	43.72	0.0002
Equal To	272	0.30	247	0.27	318	0.32	204	0.30	0.81
Above	25956	28.30	26608	28.74	26571	27.07	18747	27.86	0.05
Well Above	10237	11.16	10514	11.36	10593	10.79	7166	10.65	0.0012
Early Death (%)	1638	1.79	2189	2.36	2337	2.38	1857	2.76	<0.0001
Palliative Care Code/All patients	7691	8.39	8681	9.38	9482	9.66	6425	9.55	<0.0001
Palliative Care Code/Deaths (%)	2742	51.55	4219	56.46	5268	58.05	3560	46.58	<0.0001
Palliative Care Code/Hospice (%)	3249	61.43	2519	60.83	2324	63.03	1311	57.05	0.0003
APR DRG Weight (mean) *(SD)* *[median]*	*2.03* *1.93* *[1.33]*		*2.10* *1.97* *[1.33]*		*2.19* *2.18* *[1.33]*		*2.12* *2.08* *[1.33]*		*<0.0001*
Admit APR Severity of Illness									
Minor	300	0.33	280	0.30	375	0.38	242	0.36	0.27
Moderate	9104	9.93	9032	9.76	9920	10.11	7611	11.31	<0.0001
Major	54487	59.41	53600	57.90	56528	57.59	39448	58.62	0.0017
Extreme	27830	30.34	29656	32.04	31333	31.92	19993	29.71	0.0006
Admit APR Risk of Mortality									
Minor	4054	4.42	4219	4.56	4799	4.89	3353	4.98	<0.0001
Moderate	18659	20.34	18744	20.25	22132	22.55	15336	22.79	<0.0001
Major	46042	50.20	44767	48.36	46166	47.03	32482	48.27	<0.0001
Extreme	22966	25.04	24838	26.83	25059	25.53	16123	23.96	<0.0001

Technical Note: *Continuous variables analyzed using t-tests*; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.
APR-DRG: All-Patient Refined Diagnosis-Related Group; MS-DRG: Medicare Severity-Diagnosis Related Group

Table 8: Quartile Characteristics—Full Population (Continued)

	Quartile 1		Quartile 2		Quartile 3		Quartile 4		
Variable	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Q1 vs. Q4 p-value***
MSDRG Type									
Medical	79725	86.92	79901	86.32	84045	85.62	57785	85.87	<0.0001
Surgical	11996	13.08	12667	13.68	14111	14.38	9509	14.13	<0.0001
High MSDRG	64335	70.14	65129	70.36	67331	68.60	45662	67.85	<0.0001
MSDRG Weight (mean) *(SD)* *[median]*	*2.01* *1.93* *[1.54]*		*2.06* *1.93* *[1.57]*		*2.13* *2.16* *[1.57]*		*2.12* *2.13* *[1.54]*		<0.0001
Severe Sepsis Diagnosis Scheme									
Severe Sepsis without Shock	11274	12.29	11178	12.08	11661	11.88	7431	11.04	0.50
Severe Sepsis with Shock	8685	9.47	10581	11.43	11069	11.28	7102	10.55	<0.0001
Infection + Organ Dysfunction	71638	78.10	70710	76.39	75257	76.67	52665	78.26	<0.0001
Septic Shock (no code for Severe Sepsis)	124	0.14	99	0.11	169	0.17	96	0.14	0.69

Technical Note: *Continuous variables analyzed using t-tests*; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.
APR-DRG: All-Patient Refined Diagnosis-Related Group; MS-DRG: Medicare Severity-Diagnosis Related Group

Quartile Characteristics—Severe Sepsis Code (Focus Population): Quartile 1 vs. Quartile 4

Once the cases without the code for severe sepsis (995.92) were eliminated, the mortality indices were recalculated and the hospitals re-ranked. A total of 14 hospitals were moved up to Quartile 1; 19 hospitals were moved to Quartile 4; 14 cases were moved out of Quartile 1 and 114 hospitals were moved out of Quartile 4. A full description of the changes is listed in Table 9 and the characteristics of the focus population are shown in Table 10.

Table 9: Changes to Hospital Ranks upon elimination of patients coded with Infection plus Organ Dysfunction or Septic Shock only

Quartile Shift	Hospital Count	Change
Q1 to Q2	**14**	-1
Q2 to Q1	**13**	+1
Q2 to Q3	**18**	-1
Q2 to Q4	**2**	-2
Q3 to Q1	**1**	+2
Q3 to Q2	**14**	+1
Q3 to Q4	**17**	-1
Q4 to Q2	**2**	+2
Q4 to Q3	**12**	+1
No Change	**147**	0
Excluded	**9**	n/a

Quartile 1 (“high performers”), included 61 hospitals and 18,874 patient encounters. The mortality indices of these hospitals ranged from 0.30 to 0.82 (mean = 0.70; SD = 0.10). Quartile 4 (“high performers”), included 60 hospitals and 14,444 patient encounters. The mortality indices of Quartile 4 hospitals ranged form 1.13 to 2.39 (mean = 1.33; SD = 0.23).

There were several noticeable changes in the comparisons between the highest and lowest quartiles when isolated to only those patients coded with severe sepsis. The following factors became statistically insignificant: gender ($p = 0.85$); the age group of 45 to 65 years ($p = 0.73$); admission from court or law enforcement (e.g. correctional facility) ($p = 0.62$); missing ED flag ($p = 0.62$); APR-SOI categories of “moderate” ($p = 0.36$) and “extreme” ($p = 0.09$); and APR-ROM categories of “minor” ($p = 0.60$), “moderate” ($p = 0.98$); and “extreme” (0.06). The difference in proportion of patients discharged to hospice care who also received a code for palliative care became insignificant ($p= 0.08$). Four differences between Quartiles 1 and 4 became significant: = the proportion of patients discharged to home health care ($p < 0.0001$) and to a non-medical facility categorized as “other” ($p = 0.005$); patients with an expected mortality that fell above the population average (REM category “above”) ($p = 0.0004$); and patients with severe sepsis without shock ($p < 0.0001$).

Table 10: Quartile Characteristics— Severe Sepsis Code (Focus Population)

Variable	Quartile 1 Count	Quartile 1 %	Quartile 2 Count	Quartile 2 %	Quartile 3 Count	Quartile 3 %	Quartile 4 Count	Quartile 4 %	Q1 vs. Q4 p-value*
Hospitals	61		59		60		60		
Discharges	18874		22938		22597		14444		
Mortality Index (Ratio)	0.71		0.90		1.06		1.28		
Female	8991	47.64	10946	47.72	10517	46.54	6866	47.54	0.85
Age (mean) *(SD)* *[median]*	*64.44* *(15.79)* *[66]*	*66*	*62.96* *(16.01)* *[64]*	*64*	*62.63* *(16.16)* *[64]*	*64*	*63.96* *(16.13)* *[65]*	*65*	0.007
Age Group									
18-44 years	2129	11.28	3021	13.17	3120	13.81	1798	12.45	0.001
45 to 65 years	6678	35.38	8580	37.41	8412	37.23	5084	35.20	0.73
66 to 84 years	8363	44.31	9554	41.65	9363	41.43	6194	42.88	0.01
85 years and older	1704	9.03	1783	7.77	1702	7.53	1368	9.47	0.17
Race									
White	13370	70.84	14525	63.32	14191	62.80	7827	54.19	<0.0001
Black	3593	19.04	5407	23.57	4995	22.10	3673	25.43	<0.0001
Asian	290	1.54	642	2.80	786	3.48	672	4.65	<0.0001
Other	1211	6.42	1690	7.37	2252	9.97	2046	14.17	<0.0001
Unknown/Unavail/declined	410	2.17	674	2.94	373	1.65	226	1.56	<0.0001
Ethnicity									
Hispanic	1008	5.34	1637	7.14	2444	10.82	1217	8.43	<0.0001
Not Hispanic	12857	68.12	15591	67.97	12928	57.21	8321	57.61	<0.0001
Unknown/Unavail/Declined/Missing	5009	26.54	5710	24.89	7225	31.97	4906	33.97	<0.0001
Admission Source									
Non-facility Point of Origin	15749	83.44	18389	80.17	18992	84.05	12712	88.01	<0.0001
Clinic/Physician referral	1316	6.97	2144	9.35	1407	6.23	571	3.95	<0.0001
Transfer from SNF or ICF	1342	7.11	1943	8.47	1791	7.93	916	6.34	0.01
Transfer from another facility	416	2.20	393	1.71	379	1.68	210	1.45	<0.0001
Court/Law enforcement	51	0.27	69	0.30	28	0.12	35	0.24	0.62

. Technical Note: Continuous variables analyzed using t-tests; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.

Table 10: Quartile Characteristics— Severe Sepsis Code (Focus Population)

	Quartile 1		Quartile 2		Quartile 3		Quartile 4		
Variable	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Q1 vs. Q4 p-value***
Admitted through Emergency Department									
No	1232	6.53	1373	5.99	1361	6.02	1595	11.04	<0.0001
Yes	14920	79.05	16731	72.94	16666	73.75	10794	74.73	<0.0001
MIssing	2722	14.42	4834	21.07	4570	20.22	2055	14.23	0.62
Discharge Disposition									
Expired (Observed Mortality)	2798	14.82	4341	18.92	5069	22.43	4002	27.71	<0.0001
Home	5119	27.12	6424	28.01	6441	28.50	3784	26.20	0.06
Home health	3194	16.92	3717	16.20	3725	16.48	1972	13.65	<0.0001
Hospice (home or medical facility)	1601	8.48	1444	6.30	1060	4.69	638	4.42	<0.0001
Long-Term Care Hospital	798	4.23	904	3.94	701	3.10	411	2.85	<0.0001
Other medical facility	48	0.25	75	0.33	45	0.20	24	0.17	0.09
Other non-medical facility	215	1.14	239	1.04	148	0.65	120	0.83	0.01
Skilled Nursing Facility/Rehabilitation	5101	27.03	5794	25.26	5408	23.93	3493	24.18	<0.0001
Payer Type									
Commercial	3273	17.34	4272	18.62	3971	17.57	2212	15.31	<0.0001
County/State Assistance	94	0.50	189	0.82	144	0.64	138	0.96	<0.0001
Medicaid	2629	13.93	3566	15.55	4191	18.55	2509	17.37	<0.0001
Medicare	12164	64.45	13844	60.35	13124	58.08	8754	60.61	<0.0001
Other	303	1.61	572	2.49	552	2.44	406	2.81	<0.0001
Uninsured	411	2.18	495	2.16	615	2.72	425	2.94	<0.0001
Average Length of Stay (mean) (SD) [median]	*10.14 (11.50) [7]*		*10.85 (15.73) [7]*		*11.48 (14.25) [8]*		*12.61 (19.20) [8]*		<0.0001
ICU Stay									
No	6366	33.73	9211	40.16	8787	38.89	5400	37.39	<0.0001
Yes	12492	66.19	13727	59.84	13676	60.52	8935	61.86	<0.0001

Technical Note: *Continuous variables analyzed using t-tests*; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.
APR-DRG: All-Patient Refined Diagnosis-Related Group; MS-DRG: Medicare Severity-Diagnosis Related Group

Table 10: Quartile Characteristics— Severe Sepsis Code (Focus Population)

Variable	Quartile 1 Count	%	Quartile 2 Count	%	Quartile 3 Count	%	Quartile 4 Count	%	Q1 vs. Q4 p-value*
Expected Mortality	20.76%		21.03%		21.18%		21.72%		
Relative Expected Mortality									
Well Below	841	4.46	1302	5.68	1193	5.28	674	4.67	0.36
Below	8214	43.52	9543	41.60	9502	42.05	5819	40.29	<0.0001
Equal To	7	0.04	25	0.11	17	0.08	12	0.08	0.08
Above	7667	40.62	9351	40.77	9118	40.35	6144	42.54	0.0004
Well Above	2145	11.36	2717	11.84	2767	12.24	1795	12.43	0.003
Mortality Index (Ratio)	0.71		0.90		1.06		1.28		
Early Death (%)	1051	5.57	1432	6.24	1620	7.17	1279	8.85	<0.0001
Palliative Care Code/All patients	2877	15.24	3979	17.35	4131	18.28	2495	17.27	<0.0001
Palliative Care Code/Deaths (%)	1428	51.04	2379	54.80	2790	55.04	1732	43.28	<0.0001
Palliative Care Code/Hospice (%)	1005	62.77	912	63.16	719	67.83	375	58.78	0.08
APR DRG Weight (mean) *(SD)* *[median]*	*3.02* *(2.27)* *[3.05]*		*3.03* *(2.19)* *[3.05]*		*3.13* *(2.33)* *[3.05]*		*3.18* *(2.40)* *[3.05]*		<0.0001
Admit APR Severity of Illness									
Minor	37	0.20	52	0.23	39	0.17	32	0.22	0.61
Moderate	753	3.99	1013	4.42	961	4.25	605	4.19	0.36
Major	6525	34.57	7778	33.91	7440	32.92	4828	33.43	0.03
Extreme	11559	61.24	14095	61.45	14157	62.65	8979	62.16	0.09
Admit APR Risk of Mortality									
Minor	305	1.62	485	2.11	411	1.82	244	1.69	0.60
Moderate	1070	5.67	1425	6.21	1354	5.99	820	5.68	0.98
Major	5640	29.88	6753	29.44	6677	29.55	4162	28.81	0.03
Extreme	11859	62.83	14275	62.23	14155	62.64	9218	63.82	0.06

Technical Note: *Continuous variables analyzed using t-tests*; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.
APR-DRG: All-Patient Refined Diagnosis-Related Group; MS-DRG: Medicare Severity-Diagnosis Related Group

Table 10: Quartile Characteristics— Severe Sepsis Code (Focus Population)

Variable	Quartile 1 Count	%	Quartile 2 Count	%	Quartile 3 Count	%	Quartile 4 Count	%	Q1 vs. Q4 p-value*
MSDRG Type									
Medical	15711	83.24	18920	82.48	18531	82.01	11709	81.06	<0.0001
Surgical	3163	16.76	4018	17.52	4066	17.99	2735	18.94	<0.0001
High MSDRG	17194	91.10	20730	90.37	20596	91.14	13304	92.11	0.001
MSDRG Weight (mean) *(SD)* *[median]*	*2.90* *(2.54)* *[1.85]*		*2.88* *(2.44)* *[1.85]*		*2.99* *(2.58)* *[1.85]*		*3.12* *(2.70)* *[1.85]*		<0.0001
Severe Sepsis Diagnosis Scheme									
Severe Sepsis without Shock	10241	54.26	12147	52.96	11709	51.82	7376	51.07	<0.0001
Severe Sepsis with Shock	8633	45.74	10791	47.04	10888	48.18	7068	48.93	<0.0001

Technical Note: *Continuous variables analyzed using t-tests*; categorical variables analyzed using chi-square tests; significance measured at α = 0.05 level.
APR-DRG: All-Patient Refined Diagnosis-Related Group; MS-DRG: Medicare Severity-Diagnosis Related Group

Palliative Care Code Usage--Severe Sepsis Code (Focus Population)

Logistic regression analysis was conducted to further compare usage between Quartile 1 and Quartile 4 hospitals. Patients in Quartile 4 hospitals had 0.14 times lower odds of having code V66.7 assigned when compared to those patients in Quartile 1 hospitals. (OR: 0.86; 95% CI: 0.78 to 0.94), even though in the initial unadjusted comparisons (see Table 10), Quartile 4 hospitals had a greater proportion of their overall population receiving the palliative care code. Hospitals in the middle quartiles had greater odds of having the code when compared with Quartile 1. (See Table 11)

It was determined that there was an interaction effect between use of the palliative care code and discharge disposition. Therefore the regression analysis was also conducted without adjustment for discharge disposition to provide information about this effect. Table 11 shows that the OR for Quartile 4 compared to Quartile 1, while greater than 1.0 prior to the adjustment, after adjustment for discharge disposition, became significantly lower than 1.0. (For a comparison of unadjusted PC code usage between the quartiles, please see Appendix D.)

Table 11: Palliative Care Code Usage (Interquartile Analyses)

	Discharge Disposition Included		Discharge Disposition Excluded	
Quartile	**OR**	**95% Confidence Interval**	**OR**	**95% Confidence Interval**
1	Reference		Reference	
2	1.20	1.11 – 1.30	1.19	1.12 – 1.27
3	1.12	1.04 – 1.22	1.19	1.11 1.27
4	0.86	0.78 – 0.94	1.09	1.02 – 1.08

Approximately one-third of the observations were dropped from the regression analysis due to missing data (number of observations = 53,500), therefore, a sensitivity analysis was conducted to determine the robustness of estimates shown in Table 11. The OR estimates for Quartile 4 in comparison to Quartile 1 were similar for models with and without observations with missing values.

Palliative Care Code Usage—Intraquartile Trends (Severe Sepsis)

Further analyses were done utilizing all four quartiles order to identify any patterns or trends that may be present in the data. Results are shown in Table 12.

Gender

One particular gender did not have a more favorable chance of receiving the V66.7 code in any of the quartiles. Females in Quartile 4 had 1.10 times greater odds of having the code, the highest OR in any quartiles, but this was not statistically significant (95% CI: 0.97 - 1.26).

Age Group

The odds of having a Palliative Care code assigned increased as age increased, which is to be expected. This is seen in all quartiles, with a small deviation from this in Quartile 3, between the 45 – 65 age group (OR: 1.63; 95% CI: 1.33 to 2.00) and the 66 to 84 age group (OR: 1.62; 95% CI 1.29 to 2.03). Patients aged 85 years and older had 1.40 times greater odds of having the code in Quartile 1, when compared to those 18 to 44 years old (OR: 1.40; 95% CI: 1.01 to 1.95) within the same quartile, whereas the same age group in Quartile 4 had 1.79 times greater odds (OR: 1.79; 95% CI: 1.27 to 2.52); in Quartile 3, the odds are the highest with over two times greater odds of having the code when compared to the youngest age group within their quartile (OR: 2.17 95% CI: 1.62 to 2.79). There was no statistically significant difference in odds of receiving the PC code for patients aged 45 to 84 in Quartile 1 when compared to those in the 18 to 44 age group; this is the only Quartile in which this occurs.

Race

Non-White patients had lower odds of receiving the V66.7 code in Quartile 1 hospitals, when compared to White patients, but the results were not statistically significant. The only result which was significant was in Quartile 3, in which patients who identified as “Other” had 0.20 lower odds of getting the code when compared to White patients in the same quartile (OR: 0.80; 95% CI: 0.65 to 0.98). Asian patients in Quartile 4 hospitals had 1.36 times greater odds of having the palliative care code when compared to White patients in the same quartile (OR: 1.36; 95% CI: 1.02 to 1.83). This is similar to results for Quartile 3 hospitals in which Asian patients had 1.57 times greater odds of receiving the code (OR: 1.57; 95% CI: 1.16 to 2.12).

Ethnicity

Hispanic patients were less likely to be assigned a PC code when compared to non-Hispanics in Quartile 4 hospitals. (OR: 0.73; CI: 0.55 to 0.97). In Quartile 1 hospitals, Hispanics had 1.34 times greater odds of having the code assigned, but the results were not significant (OR: 1.34; 95% CI: 0.97 to 1.85). Results for Quartile 2 and 3 were also not statistically significant for differences between Hispanics and non-Hispanics.

Primary Payer

The significance of primary insurance provider type varied among the quartiles. In Quartile 1, those on Medicaid had 0.22 lower odds of having the PC code when compared to those with commercial insurance (OR: 0.78; 95% CI: 0.61 to 1.01), but this was not statistically significant. Conversely, those in Quartile 2 had 1.30 times greater odds (OR: 1.30; 95% CI: 1.06 to 1.58). There was no difference for Medicaid recipients receiving the PC code in Quartile 4, but patients who were uninsured had 0.51 lower odds of receiving it when compared to patients in the same quartile who held commercial insurance (OR: 0.49; 95% CI: 0.30 to 0.80); patients with Medicaid had even odds (OR: 1.01; 95% CI: 0.78 to 1.30). There were no statistically significant differences among insurance types in Quartile 3 hospitals.

Admission Source

Admission from a skilled nursing facility (SNF) or intermediate care facility (ICF) was associated with the presence of the V66.7 code across all quartiles. Quartile 1 patients had almost twice the likelihood of having a PC code (OR: 1.90; 95% CI: 1.50 to 2.40) when compared to patients with a non-facility point of origin (e.g. home). Quartile 2 patients admitted from SNF/ICF had 1.53 times greater odds (OR: 1.53; 95% CI: 1.31 to 1.79) and those in Quartile 4 had 1.26 times greater odds (OR: 1.26; 95% CI 1.00 to 1.59) when compared to those within their respective quartiles who were admitted from a non-facility point of origin. Quartile 3 patients had 0.18 lower odds of having a PC code (OR: 0.82; 95% CI: 0.69 to 0.97).

The only other statistically significant finding was within Quartiles 3 and 4. Patients who were admitted as a result of a physician or clinic referral had opposite results when compared to patients admitted from a non-facility point of origin within their respective quartiles. Quartile 3 patients admitted from a non-facility point of origin had 0.24 lower odds of having a PC code (OR: 0.76; 95% CI: 0.64 to 0.94) whereas those in Quartile 2 had 1.59 times greater odds (OR: 1.59; 95% CI: 1.25 to 2.01).

Emergency Department

Patients in Quartile 1 who were admitted through the Emergency Department had 0.33 lower odds of having the PC code than those who were directly admitted (OR: 0.67; 95% CI: 0.51 to 0.87). This is in contrast to the other quartiles for which there was no significant difference between those admitted through the Emergency Department and those who were not.

Readmission

Patients in Quartile 1 hospitals who had been readmitted to the hospital within thirty days of a previous inpatient discharge were less likely to have a PC code than those who had not (OR: 0.67; 95% CI: 0.51 to 0.87). Patients in Quartile 4 hospitals, were also less likely to have the PC code, however, those results were not significant (OR: 0.87; 95% CI: 0.66 to 1.16). This pattern is seen in the other two Quartiles, although, similar to Quartile 4, the results were not statistically significant.

Discharge Disposition

Discharge disposition was a significant indicator of V66.7 in all categories in all quartiles. Patients who were discharged to hospice care (either inpatient or home) had the greatest odds of getting assigned the code when compared to those who died in-hospital within their own quartile. The highest was for patients in Quartile 4; they had 1.82 times greater odds of getting the code (OR: 1.82; 95% CI: 1.44 to 2.30). Patients in Quartile 1 hospitals had 1.59 times greater odds (OR: 1.59; 95% CI: 1.36 to 1.86). The odds ratios become larger as the Quartiles increase (mortality index is worse)—Quartile 2 patients had 1.48 times greater odds (OR: 1.48; 95% CI: 1.27 to 1.73) and Quartile 3 patients had 1.79 times greater odds (OR: 1.79; 95 CI: 1.50 to 2.14). Patients discharged to home or other non-hospice facilities had very low odds of having the PC code.

Intensive Care Unit Stay

There was no significant increase or decrease in odds of receiving the PC code for patients who had a stay in the Intensive Care Unit in Quartiles 1, 3, or 4, when compared to those within their quartile who did not have an ICU stay. Patients in Quartile 2 hospitals, however, had 1.36 times greater odds of having the PC code (OR: 1.36; 95% CI: 1.21 to 1.53).

Medicare Severity-Diagnosis Related Group (MS-DRG)

Patients who were assigned a surgical MS-DRG had lower odds of having the PC code when compared to those assigned a medical MS-DRG within the respective quartile; these results were significant for all quartiles except Quartile 1. Patients in Quartile 2 hospitals had 0.32 lower odds of having the code (OR: 0.68; 95% CI: 0.56 to 0.83); Quartile 3 hospitals had 0.23 lower odds (OR: 0.77; 95% CI: 0.63 to 0.94); and Quartile 4 had 0.22 lower odds (OR: 0.78, 95% CI: 0.61 to 0.99).

Severe Sepsis With and Without Shock

Patients who were coded as having severe sepsis with septic shock were less likely to have a PC code than those who did not have septic shock in three of the four quartiles when compared to patients who did not have shock in their respective quartiles. Patients in Quartile 1 hospitals had 0.15 lower odds (OR: 0.85; 95% CI: 0.75 to 0.97); Quartile 2 had 0.19 lower odds (OR: 0.81; 95% CI: 0.73 to 0.91); and Quartile 4 had 0.32 lower odds (OR: 0.78; 95% CI: 0.68 to 0.90). The odds of receiving the PC code in Quartile 3 were approximately even (OR: 0.94; 95% CI: 0.83 to 1.05).

Table 12: Palliative Care Code Usage (Intraquartile analyses)-- Severe Sepsis Code (Focus Population)

Palliative Care	Quartile 1			Quartile 2			Quartile 3			Quartile 4		
Variable	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**
Gender												
Male	Reference			Reference			Reference			Reference		
Female	1.00	0.88	1.13	0.99	0.89	1.09	0.98	0.90	1.08	1.10	0.97	1.26
Age Group												
18-44 years	Reference			Reference			Reference			Reference		
45 to 65 years	1.24	0.95	1.61	1.46	1.18	1.81	1.63	1.33	2.00	1.46	1.11	1.91
66 to 84 years	1.26	0.95	1.67	1.70	1.35	2.14	1.62	1.29	2.03	1.76	1.31	2.37
85 years and older	1.40	1.01	1.95	1.83	1.39	2.40	2.13	1.62	2.79	1.79	1.27	2.52
Race												
White	Reference			Reference			Reference			Reference		
Black	0.90	0.77	1.05	1.05	0.93	1.19	0.99	0.87	1.13	0.88	0.75	1.03
Asian	0.88	0.50	1.55	0.96	0.70	1.33	1.57	1.16	2.12	1.36	1.02	1.83
Other	0.83	0.60	1.14	1.12	0.87	1.43	0.80	0.65	0.98	1.30	0.96	1.76
Hispanic												
No	Reference			Reference			Reference			Reference		
Yes	1.34	0.97	1.85	0.96	0.76	1.22	1.05	0.86	1.27	0.73	0.55	0.97
Primary Payer												
Commercial	Reference			Reference			Reference			Reference		
County/State Assistance	0.70	0.31	1.61	0.65	0.32	1.31	1.29	0.61	2.72	0.97	0.50	1.90
Medicaid	0.78	0.61	1.01	1.30	1.06	1.58	1.02	0.85	1.24	1.01	0.78	1.30
Medicare	1.09	0.89	1.34	1.09	0.92	1.29	1.02	0.86	1.21	0.96	0.77	1.20
Other	0.94	0.58	1.52	1.19	0.82	1.71	0.96	0.65	1.40	1.39	0.84	2.29
Uninsured	0.93	0.58	1.47	1.02	0.68	1.55	0.81	0.56	1.16	0.49	0.30	0.80
Admission Source												
Non-facility Point of Origin	Reference			Reference			Reference			Reference		
Clinic/Physician referral	1.22	0.94	1.60	0.76	0.64	0.91	1.59	1.25	2.01	1.15	0.85	1.56
Transfer from SNF or ICF	1.90	1.50	2.40	1.53	1.31	1.79	0.82	0.69	0.97	1.26	1.00	1.59
Transfer from another facility	1.14	0.71	1.81	1.22	0.86	1.73	1.01	0.66	1.57	1.02	0.66	1.59
Court/Law enforcement	0.92	0.28	3.06	1.32	0.38	4.61	0.27	0.05	1.41	0.53	0.10	2.74

Table 12: Palliative Care Code Usage (Intraquartile analyses)--Severe Sepsis Code (Focus Population)

Palliative Care	Quartile 1			Quartile 2			Quartile 3			Quartile 4		
Variable	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**
Emergency Department												
No	Reference			Reference			Reference			Reference		
Yes	0.67	0.51	0.87	1.03	0.84	1.25	1.13	0.90	1.41	0.90	0.71	1.15
Readmission												
No	Reference			Reference			Reference			Reference		
Yes	0.70	0.55	0.89	0.97	0.80	1.18	0.91	0.72	1.15	0.87	0.66	1.16
Discharge Disposition												
Expired	Reference			Reference			Reference			Reference		
Home	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.03	0.02	0.04
Home health	0.02	0.02	0.03	0.04	0.03	0.04	0.03	0.02	0.03	0.04	0.03	0.06
Hospice	1.59	1.36	1.86	1.48	1.27	1.73	1.79	1.50	2.14	1.82	1.44	2.30
LTCH	0.05	0.03	0.07	0.04	0.03	0.06	0.07	0.05	0.11	0.06	0.04	0.10
Other Facility	0.08	0.04	0.13	0.02	0.01	0.05	0.08	0.04	0.15	0.08	0.03	0.22
SNF/Rehab	0.04	0.03	0.05	0.06	0.05	0.07	0.06	0.05	0.07	0.07	0.06	0.09
ICU Stay												
No	Reference			Reference			Reference			Reference		
Yes	0.98	0.93	1.03	1.36	1.21	1.53	0.94	0.83	1.07	0.95	0.81	1.11
APR DRG Weight	1.06	1.02	1.10	1.10	1.06	1.14	1.05	1.02	1.09	1.07	1.03	1.11
MS-DRG Type												
Medical	Reference			Reference			Reference			Reference		
Surgical	0.81	0.64	1.03	0.68	0.56	0.83	0.77	0.63	0.94	0.78	0.61	0.99
Severe Sepsis												
Without Shock	Reference			Reference			Reference			Reference		
With Shock	0.85	0.75	0.97	0.81	0.73	0.91	0.94	0.83	1.05	0.78	0.68	0.90

High MS-DRG Level Assignment— Severe Sepsis Code (Focus Population)

Logistic regression analysis was conducted to compare the assignment of the highest level of MS-DRGs within the MS-DRG groupings (singlet, doublet, or triplet) between Quartile 1 and Quartile 4 hospitals. Patients in Quartile 4 hospitals had close to even odds of being assigned the highest weight of MS-DRG when compared to Quartile 1 hospitals. (OR: 1.04; 95% CI: 0.96 to 1.12). Quartile 2 had 0.11 lower odds of having the highest level assigned (OR: 0.89; 95% CI: 0.83 to 0.95) and this was the only significant finding. Patients in Quartile 3, like Quartile 4, had close to even odds of having the highest MS-DRG level assigned when compared to Quartile 1 hospitals (OR: 0.95; 95% CI: 0.91 to 1.05).

Table 13: High MS-DRG Level Assignment (Interquartile Analyses)—Focus Population

Quartile	OR	95% Confidence Interval
1	Reference	
2	0.89	0.83 – 0.95
3	0.95	0.91 – 1.05
4	1.04	0.96 – 1.12

MS-DRG Level Assignment—Intraquartile Trends (Focus Population)

Variables potentially contributing to the results were examined for all four quartiles, utilizing the significant variables from the logistic regression models. (See Table 14 below.)

Table 14: Medicare-Severity Diagnosis Related Group Level--Severe Sepsis Code (Focus Population): Interquartile Analyses

High MS-DRG	Quartile 1			Quartile 2			Quartile 3			Quartile 4		
Variable	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**	**OR**	**95%**	**CI**
Admission Source												
Non-facility Point of Origin	Reference			Reference			Reference			Reference		
Clinic/Physician referral	1.07	0.87	1.31	1.41	1.19	1.67	1.32	1.07	1.62	0.96	0.70	1.31
Transfer from SNF or ICF	0.92	0.71	1.18	1.24	0.98	1.58	1.19	0.93	1.52	1.07	0.77	1.49
Transfer from another facility	1.62	0.97	2.71	1.37	0.86	2.19	1.03	0.66	1.61	1.19	0.62	2.29
Court/Law enforcement	0.64	0.25	1.66	0.93	0.46	1.91	1.17	0.26	5.29	2.73	0.35	21.51
Discharge Disposition												
Expired	Reference			Reference			Reference			Reference		
Home	0.03	0.02	0.05	0.02	0.02	0.04	0.02	0.01	0.03	0.05	0.04	0.07
Home health	0.06	0.04	0.09	0.05	0.03	0.07	0.03	0.02	0.05	0.09	0.06	0.12
Hospice	0.28	0.17	0.46	0.18	0.11	0.28	0.09	0.05	0.15	0.37	0.21	0.63
LTCH	0.64	0.30	1.41	0.23	0.13	0.41	0.10	0.06	0.18	0.24	0.14	0.43
Other Facility	0.07	0.04	0.13	0.08	0.04	0.14	0.03	0.02	0.07	0.14	0.07	0.30
SNF/Rehab	0.12	0.08	0.18	0.08	0.05	0.12	0.06	0.04	0.09	0.16	0.12	0.23
Primary Payer												
Commercial	Reference			Reference			Reference			Reference		
County/State Assistance	1.46	0.61	3.48	0.46	0.31	0.69	1.94	0.99	3.81	0.66	0.37	1.20
Medicaid	1.19	0.99	1.42	0.96	0.83	1.11	1.20	1.03	1.39	0.82	0.67	1.02
Medicare	1.23	1.06	1.44	1.19	1.04	1.36	1.33	1.16	1.53	0.99	0.81	1.21
Other	1.25	0.81	1.91	0.93	0.70	1.23	1.24	0.92	1.67	1.41	0.89	2.23
Uninsured	1.08	0.78	1.50	1.02	0.76	1.36	0.92	0.71	1.20	0.72	0.51	1.01
Age Group												
18-44 years	Reference			Reference			Reference			Reference		
45 to 65 years	0.98	0.83	1.16	1.04	0.91	1.18	0.99	0.86	1.14	0.75	0.61	0.92
66 to 84 years	0.68	0.56	0.82	0.72	0.61	0.84	0.67	0.57	0.79	0.52	0.41	0.66
85 years and older	0.44	0.35	0.57	0.68	0.54	0.86	0.49	0.39	0.62	0.41	0.30	0.55

Admission Source

There were no significant differences in assignment of the highest level of MS-DRG among the different admission sources. In Quartile 1 hospitals, patients who were transferred from another facility other than a Skilled Nursing Facility, Intermediate Care Facility or Acute Care Hospital, had 1.62 times greater odds of having the highest MS-DRG level assigned when compared to patients within the same quartile who were admitted from a non-facility point of origin (OR: 1.62, 95% CI: 0.97 to 2.71). Patients in Quartile 4 hospitals who were admitted from a Court/Law Enforcement source (e.g. correctional facility), had an odds ratio of 2.73 when compared to those who were admitted from a non-facility point of origin, but the results were also not significant (95% CI: 0.35 to 21.51).

Discharge Disposition

Discharge disposition was significant in most categories in all Quartiles. Patients had lower odds of having the highest-weighted MS-DRG if they were discharged alive compared to those who died in-hospital.

In Quartile 1 hospitals, patients who were discharged to a long-term care hospital (LTCH) had the highest odds when compared to those who died (OR: 0.64; 95% CI: 0.30-1.41); however, these results were not statistically significant. The next highest within this quartile were those patients discharged to hospice (OR: 0.28; 95% CI: 0.17 to 0.46). In Quartile 2, the highest odds were also for patients discharged to an LCTH, but in the case of this quartile the results were statistically significant (95% CI: 0.13 to 0.41). The same is true in Quartile 3 hospitals, where the odds were 0.10 (95% CI: 0.06 to 0.18).

In Quartile 4, patients discharged to hospice care had 0.63 lower odds of having the higher MS-DRG assignment (OR: 0.37; 95% CI: 0.21 to 0.63) when compared to those who died in hospital. In all Quartiles, patients discharged to home were the least likely to have a higher level MS-DRG assigned.

Primary Payer

There were no significant differences in odds of getting the highest-weighted MS-DRG when examining payer source except in one case. In Quartile 2, patients who had county or state assistance as their primary payer source had 0.54 lower odds of having the higher MS-DRG assigned (OR: 0.46, 95% CI 0.31 to 0.69).

Age Group

Whereas the odds of assignment of the Palliative Care code increased as age groups increased chronologically, the opposite occurs for the assignment of the MS-DRG. When comparing patients older than 44 years of age to adults younger than 45 years, the older patients had significantly lower odds of having the higher level of MS-DRG assigned in all cases. Patients aged 85 years and older were approximately half as likely to get the higher level MS-DRG than those aged 18 to 44 years: Quartile 1 (OR: 0.44; 95% CI: 0.35 to 0.57); Quartile 2 (OR: 0.68, CI: 0.54 to 0.86); Quartile 3 (OR: 0.0.49, 95% CI: 0.39 to 0.62); and

Quartile 4 (OR: 0.41; CI: 0.30 to 0.55). All of these results were statistically significant.

The findings of this study, by study objective, are summarized in Table 15.

Table 15: Summary of Results

Specific Aim 1	To compare usage of the ICD-9-CM Code V66.7 between hospitals who have better-than-expected mortality rates ("high performers") and those who have worse-than-expected in-hospital mortality rates ("low performers") in patients coded with severe sepsis and/or septic shock.
Hypothesis	High-performing hospitals will have higher usage of the ICD-9-CM code for palliative care than low-performing hospitals.
Result	Hospitals in Quartile 4 ("low performers") hospitals had a higher rate of palliative care code usage for all patients with a code for severe sepsis when compared to Quartile 1 ("high performers") hospitals. The usage of palliative care codes for patients who die in-hospital or are discharged to hospice care is higher for Quartile 1 hospitals. The likelihood of getting a palliative care code is lower for Quartile 4 hospitals when compared to those in Quartile 1, the result of a strong interaction effect between use of this code and discharge disposition.
Specific Aim 2	To further examine variations in coding between low- and high-performing hospitals by determining the manner in which severe sepsis is coded and its association with utilization of the palliative care ICD-9 code.
Hypothesis	There will be a difference in practices for coding severe sepsis between low-performing and high-performing hospitals.
Result	There was no significant difference in the rate of patients who had a code for infection plus organ dysfunction or for septic shock without a code for severe sepsis (which indicates an error in coding).
Specific Aim 3	To compare the level of the Medicare-Severity Diagnosis Related Groups (MS-DRGs) assigned between low- and high-performing hospitals.
Hypothesis	Patients at high-performing hospitals will have MS-DRGs assigned that are at a higher level (weight) than those at low-performing hospitals
Result	There was no statistically significant difference between Quartile 1 and Quartile 4 hospitals in the likelihood of patients being assigned a higher level of MS-DRG codes. Patients' likelihood of receiving the higher level code decreases as age increases.

CHAPTER FIVE: DISCUSSION

This chapter provides a discussion of the results of the study by specific aim. It will include a discussion of the usage of ICD-9-CM code for palliative care and the assignment of the highest-level of MS-DRG code among the hospital quartiles, in particular, between Quartile 1 and Quartile 4 hospitals. It also summarizes the study's limitations, strengths, and implications for future research.

Palliative Care Code Usage— Severe Sepsis Code (Focus Population)

Specific Aim 1: To compare usage of the ICD-9-CM Code V66.7 between hospitals who have better-than-expected mortality rates ("high performers") and those who have worse-than-expected in-hospital mortality rates ("low performers") in patients coded with severe sepsis and/or septic shock.

Patients with severe sepsis in Quartile 4 hospitals had 0.14 lower odds (OR: 0.86; 95% CI: 0.78 to 0.94) of having a code for palliative care than those in Quartile 1 hospitals when controlled for gender, age group, race, ethnicity, primary payer type, admission source, emergency department admission, readmission, discharge disposition, intensive care unit stay, APR-DRG weight, MS-DRG type (medical vs. surgical), and severe sepsis type (with or without shock). However, the middle quartiles have higher odds of having the palliative care code when compared with Quartile 1 (see Table 11); all results were statistically significant at the $\alpha = 0.05$ level.

The independent variables used in the logistic regression model were examined for each Quartile to identify any patterns that may shed light on possible influences to these results. The most notable observations are discussed below.

Patient Demographics

Females had similar odds of receiving a palliative care code when compared to males in the four quartiles. Age, however, was significant in all categories in all quartiles with two exceptions in Quartile 1 hospitals (patients in the 44 to 65 and 66 to 84 age groups). Otherwise, in all cases, the odds of having a palliative care code increased as the age group increased. These results are to be expected.

Race was not significant except for Asian patients in Quartile 3 and 4 hospitals; where they had higher odds of having a palliative care code when compared to White patients. There is no clear reason why this would be the case except that in these quartiles, there was slightly higher proportions of Asian patients with severe sepsis compared to Quartile 1 and 2. A limitation of this study is that the hospitals are blinded; it is not possible to determine the essential characteristics of the individual hospitals in the quartiles to come to any assumptions or conclusions.

Hispanic patients with severe sepsis had 0.73 times lower odds of having the palliative care code when compared to non-Hispanics in Quartile 4. Quartile 4 had a higher proportion of Hispanics than Quartile 1 (8.43% vs. 5.34%, p <

0.0001). There was also a higher proportion of missing ethnicity data--either due to patient refusal to answer, data not being entered, or patients not being asked—in Quartile 4 (33.97% to 26.54%, $p < 0.0001$). The inability to account for one-third of the data (or one-fourth in the case of Quartile 1), could confound these results. Differing attitudes regarding end-of-life could play a role in the results for both race and ethnicity, but analyses of this was not in the scope of this study's aims.

Primary payer type also yielded interesting results. There was a statistically significant difference in the proportion of uninsured patients with severe sepsis in Quartile 1 and Quartile 4 hospitals (2.18 vs. 2.94, $p < 0.0001$), but in Quartile 4 hospitals, uninsured patients were less likely to have a palliative care code when compared to those with commercial insurance within the same quartile; in Quartile 1, there is no significant difference in odds of uninsured patients receiving this code. Quartile 1 hospitals had a higher proportion of patients with severe sepsis on Medicare than did Quartile 4 hospitals (64.65% vs. 60.61%, $p < 0.0001$). This is significant because Quartile 1 hospitals had a higher proportion of patients being discharged to hospice (home or inpatient) than Quartile 4 hospitals (8.48% vs. 4.42%, $p < 0.0001$). This could imply that the resources available for hospice care (i.e. insurance coverage) is greater for Quartile 1 hospitals, enabling the hospitals to more effectively place patients in hospice care; in Quartile 4, where the uninsured patient population is greater, placement into hospice may be more difficult due to financial barriers. If the palliative care code represents a palliative care service, or care management service, facilitating transfers of patients to hospice care could potentially impact the odds of receiving a palliative care code (although in Quartile 1 hospitals, the differences in odds between the various payer types and commercial insurance were not statistically significant); more importantly, it can decrease the observed mortality and thus decrease the mortality index.

Discharge Disposition

Patients were discharged to hospice at double the rate in Quartile 1 hospitals compared to Quartile 4 hospitals, as mentioned above, while in-hospital deaths were almost double the rate in Quartile 4 hospitals (27.71% vs. 14.82%, $p < 0.0001$). This result, in the context of the higher proportion of Medicare patients in Quartile 1 hospitals, suggests that not only are Quartile 1 hospitals moving patients out prior to death at a higher rate, they may have greater ability to do this due to the higher proportion of coverage by Medicare (although, the difference in the proportion of Medicare is not as large). This argument might be furthered by the data which shows that in Quartile 1 hospitals, 62.77% of patients who were discharged to hospice had a palliative care code; patients in Quartile 4 hospitals who were discharged to hospice had a palliative care code 58.78% of the time ($p = 0.08$). The difference in these rates between the lowest and highest quartile are not significant, but given the fact that the rates of discharges to hospice in Quartile 1 are double that of Quartile 4, the observed mortality is rate is almost half that of Quartile 4, and the likelihood of hospice discharges in Quartile 4 receiving a palliative care code is high when compared to those who die in hospital—this could account for the apparent flip in results between the rate of all patients with the palliative care code (Quartile 1 < Quartile 4) and the odds of a patient receiving a palliative care code (Quartile 4 < Quartile 1).

Patients with severe sepsis in Quartile 1 who are discharged to hospice have 1.59 times greater odds of having a palliative care code when compared to those who died during the admission (OR: 1.59; 95% CI: 1.36 to 1.86). In Quartile 4, the odds increase to 1.82 times greater odds when compared to patients who died in hospital within this Quartile (OR: 1.82; 95% CI: 1.44 to 2.30). Similar results are shown in Quartiles 3 and 4 (see Table 12). This may indicate that when palliative care codes do happen, it is more often in conjunction with moving patients to hospice prior to death, instead of the bulk of the services being used to support patients who are actively dying, or families of these patients. A patient does not have to be seen by a formal palliative care service in order to get the code; if a Family Medicine physician, for example, has a discussion with a family and the decision is to provide comfort measures only—this can be coded for palliative care. The higher odds in the lower performing hospitals (Quartiles 3 and 4) could be indicative of difference in documentation or coding.

Admission

In Quartile 1 and Quartile 4 hospitals, patients who were admitted from a Skilled Nursing Facility (SNF) or Intermediate Care Facility (ICF) were more likely to receive a palliative care code when compared to patients with severe sepsis within their quartile who were admitted from a non-facility point of origin (e.g.

home). In Quartile 1, the odds are almost double (OR: 1.90; 95% CI: 1.50 to 2.40); in Quartile 4, the odds are 1.26 times greater when compared to those admitted from a non-facility point of origin (OR: 1.26; 95% CI: 1.00 to 1.59). There is a similar pattern in Quartile 2 hospitals, but in Quartile 3, patients transferred from an SNF or ICF had 0.18 lower odds of having a palliative care code (OR: 0.82; 95% CI: 0.69 to 0.97}. In this same Quartile, patients who were admitted because of a clinic or physician referral had 1.59 times greater odds of having the palliative care code (OR: 1.59; 95% CI: 1.25 to 2.01). In Quartile 2, this group has lesser odds of having the code (OR: 0.76; 95% CI: 0.64 to 0.91). This variation needs to be studied further. The higher likelihood of SNF/ICF transfers having the palliative care code when compared to those who are admitted from a non-facility point of origin could be attributed to the difference in health status (i.e. a patient admitted from home would tend to be in a healthier state than one transferred from a SNF/ICF).

Patients who present to the Emergency Department (ED) and are subsequently admitted to the hospital are less likely to receive a palliative care code in Quartile 1 hospitals when compared to those who are directly admitted (i.e. patients admitted from a clinical referral, SNF, ICF, etc., without being sent to the ED first). They have 0.33 lower odds (OR: 0.67; 95% CI: 0.51 to 0.67), whereas in other hospitals there are no significant differences in odds. The same is true for patients readmitted within 30 days of a previous inpatient discharge when compared to those who were not readmitted within this timeframe (OR: 0.70; 95% CI: 0.55 to 0.89). Readmissions have been noted to be a significant indicator of mortality (42), so it is unclear why patients in the top-performing hospitals (Quartile 1) would have lower odds of getting a palliative care code if they are readmitted. Readmission rates were not calculated for the quartiles for this study as more data are needed than was obtained for this study; this is another area for further analysis.

Medicare Severity-Diagnosis Related Group (MS-DRG)

Patients with a surgical MS-DRG in Quartile 4 had 0.22 lower odds (OR 0.78; 95% CI: 0.61 0.99) of having a palliative care code when compared to patients within their quartile who were classified with a medical MS-DRG. Patients in Quartile 1 had 0.19 lower odds (OR: 0.81; 95% CI: 0.64 to 1.03) when compared with patients within their quartile with a medical MS-DRG, although the result was not statistically significant. Similar, statistically significant results are also seen in the middle quartiles (see Table 12). It is unclear what the potential contributors to these results are without further analysis. One factor may be the significantly lower rate of patients assigned a surgical (MS-DRG see Table 10). Differences in rates of palliative care code usage between medical and surgical MS-DRGs for in-hospital deaths within the quartiles are not statistically significant (See Table 16), however, Quartile 4 does have a lower rate when compared to Quartile 1 ($p = 0.002$).

Table 16: Palliative Care Codes (Deaths by MS-DRG type)

MS-DRG Type	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Medical				
Rate of PC code usage	50.58%	55.12%	55.43%	43.18%
# with PC code/Deaths	121/2404	2017/3659	2367/4270	1465/3393
Surgical				
Rate of PC code usage	53.81%	53.08%	52.94%	43.84%
# with PC code/Deaths	212/394	362/682	423/799	267/609
P-Value	0.24	0.57	0.19	0.76

Severe Sepsis

Patients who have been coded as severe sepsis with septic shock are less likely to have a palliative care code than those who are not coded as having septic shock. Patients with septic shock in Quartile 1 hospitals have 0.85 times less odds of having the code than patients within their quartile who do not have septic shock (OR: 0.85; 95% CI: 0.75 to 0.97) ; in Quartile 4 hospitals, the results are lower (OR; 0.78; 95% CI: 0.68 to 0.90). This is also seen in the middle quartiles, however, the results for Quartile 1 are not significant (95% CI: 0.83 to 1.05). This could be related to a higher in-hospital mortality rate for patients with septic shock (See Table 17). As we have seen in the previous section ("Discharge Disposition"), patients who die in-hospital have lower odds of receiving palliative care than those who are discharged to a hospice.

Table 17: Observed Mortality Rates—Severe Sepsis with vs. without Septic Shock

Severe Sepsis Category	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Severe Sepsis				
Observed Rate	8.42 %	11.20%	14.11%	18.82%
Deaths/Discharges	862/10241	1360/12147	1652/11709	1388/7376
Severe Sepsis with Septic Shock				
Observed Rate	22.43%	27.62%	31.38%	36.98%
Deaths/Discharges	1936/8633	2981/10791	3417/10888	2614/7068

Severe Sepsis Coding

Specific Aim 2: To further examine variations in coding between low- and high-performing hospitals by determining the manner in which severe sepsis is coded and its association with utilization of the palliative care ICD-9 codes.

There were no differences in the patients who had diagnosis codes of infection plus organ dysfunction between the two quartiles. This coding scheme, as described by Wang and Angus (15, 41) might be better applied in conjunction with a study that involves chart review so that temporal relationships between the diagnoses could be established. The proportion of erroneous coding of septic shock without a corresponding code for severe sepsis was no different between the highest and lowest quartiles.

The differences in the actual use of the codes for sepsis and septic shock cannot be interpreted in terms of correctness, as that would require a chart review. The identification of sepsis and septic shock that is present on admission is a challenge for hospitals which adds yet another level of potential confounding when assessing accuracy (32, 33). Incorrect identification of severe sepsis, or lack thereof, can have significant impact on hospital-reported outcomes, but that is outside the focus of this study.

Due to the lack of a statistically significant difference in coding practice between the high- and low-performing hospitals, further analyses relating to palliative care coding was not pursued.

MS-DRG Level

Specific Aim 3: To compare the level of the Medicare-Severity Diagnosis Related Groups (MS-DRGs) assigned between low- and high-performing hospitals.

The results of this study did not support the hypothesis that high performing hospitals (Quartile 1) would have a higher proportion of patients who were assigned higher-level (higher-weighted) MS-DRGs; the results were the opposite of the hypothesis. Patients in Quartile 4 hospitals had a higher proportion (unadjusted) of patients who were assigned the higher-level MS-DRG when compared to Quartile 1 hospitals (92.11% vs. 91.10%, $p < 0.0001$) The odds of patients in Quartile 4 hospitals receiving the higher-level MS-DRG were not, however, statistically significant when compared to Quartile 1 hospitals (OR: 1.04; 95% 0.96 to 1.12). Discussion of the intraquartile analyses of MS-DRG assignment follows.

Demographics

Intraquartile analyses were conducted to identify potential predictors of patients with severe sepsis having a higher-level MS-DRG. Admission source was not significant in any category within any quartile. Primary payer type was only significant in two cases. Patients in Quartile 2 who had county or state assistance had 0.48 lower odds of having been assigned the higher MS-DRG when compared to patients within their Quartile who had commercial insurance (OR: 0.52; 95% CI: 0.31 to 0.90). Patients in Quartile 4 who had Medicaid listed as their primary payer and 0.29 lower odds of having the highest level of MS-DRG when compared to those within their quartile with commercial insurance (OR: 0.71; 95% CI: 0.54 to 0.94). This could be a reflection of a younger and healthier pool of patients receiving Medicaid than commercial insurance, but examination of differences in age groups doesn't support this. More analyses are needed.

Age was significant in these analyses; the older the age group, the lesser the odds of having a higher-level MS-DRG. These results were significant for all quartiles, except for the age group of 45 to 65 years in Quartiles 1 through 3. The decrease in odds was larger in Quartile 4 hospitals than in Quartile 1 hospitals. In Quartile 1, patients in the age group of 66 to 84 years had 0.64 lower odds of having the higher-level MS-DRG when compared to 18 to 44 year olds within the same quartile (OR: 0.36; 95% CI: 0.28 to 0.56); the odds drop to 0.26 (95% CI: 0.19 to 0.36) for those in the 85 years and older group. In Quartile 4, patients in the age group of 66 to 84 years had 0.76 lower odds of having the higher MS-DRG (OR: 0.24; 95% CI: 0.18 to 0.33) and 0.83 lower odds if they are in the 85 years and older group (OR: 0.17; 95% CI: 0.11 to 0.25). This needs to be analyzed more in-depth, preferably with medical chart review, to determine if major comorbidities and complications are not being adequately captured through documentation and/or coding.

Limitations

There are several limitations of this study. The data used were obtained from the Vizient, Inc. Clinical Database/Resource Manager (CDB/RM). The hospitals represented in these data are academic health centers (AHC) and their affiliated hospitals, which may limit generalizability; however, the hospitals in the CDB/RM are from various parts of the country and represent a diverse population of patients. The hospitals were de-identified and characteristics of the hospitals (e.g. trauma level, Medicare population, geographic area (i.e. urban vs. rural), number of beds, demographics, etc.) were not included in the analyses. The focus on education and research in academic medical centers could possibly influence results when compared to non-academic medical centers, but this requires further research with unblinded hospital information.

The data were derived from administrative data and did not include clinical data (i.e. vital signs, severity scores such as APACHE II scores, etc.), therefore the true severity of the patients could not be completely assessed. The differences in the coding of patients with severe sepsis with and without shock cannot be assessed for accuracy without medical record review; this also holds true for assessing accuracy of comorbidity and complication capture and other elements of the administrative data (e.g. admission source, discharge disposition). The number of diagnoses for each patient was not included in the data; this may have helped explain differences between the hospital quartiles related to patient acuity.

There was also no way of determining what was behind the palliative care code being applied—palliative care services utilized versus physician documentation of comfort measures. This information would have been very useful in further assessing the differences in palliative care code usage between patients who died in-hospital and those who were discharged to hospice. However chart review would be needed to explore this consideration.

The generalizability may also be limited because hospitals converted to ICD-10 coding in October 2015. The codes used in this study are no longer applicable, however, the basis of the central issue—coding practices, is still relevant. Further examination of the effects of the different coding schemes on calculated patient mortality risk (ICD-9-CM vs. ICD-10-CM), mortality indices and hospital performance ranking is need.

Strengths

A strength of this study was that it used data from Vizient, Inc., which has data quality thresholds that have to be met in order to be included in the Clinical Database/Resource Manager (CDB/RM). The requirements for data reliability are consistent for all participants which provides consistency. The CDB/RM has also been shown to be a reliable proxy for medical records when the latter are unavailable for use (38). Data provided included variables that have been found to be significant in other studies looking at the effect coding on mortality metrics. The population utilized is large and diverse, which contributes to high generalizability. The use of patients with a code for severe sepsis enabled analyses of a large population that fell into medical and surgical diagnostic categories and have a high mortality rate.

Future Research

There are many opportunities for future research. The effects that the change to ICD-10-CM has on mortality metrics is of particular interest. There are two codes for severe sepsis within this system—R65.20 (without shock) and R65.21 (with shock)—this provides an opportunity to revisit previous research under this new context.

The use of the palliative care code versus the use of a palliative care service is also something that needs further exploration. Palliative Care services are working to gain more footing in healthcare systems; having more studies explore their impact may help in this endeavor (51). The results of this study suggest that when looking at improving in-hospital mortality, hospitals should look at the use of this service. . Attention to the types of hospice services utilized and their impact on mortality metrics should also be given; for example, evaluation of whether hospitals which have inpatient hospice units have a greater advantage over hospitals who rely on privately-owned or home-based hospice services.

The potential for “gaming the system” in order to thrive under the rules set by CMS also needs to be explored. A patient is excluded from CMS mortality measures if they have been admitted to hospice within the previous 12 months of admission up through the first day of admission. This could potentially spark an effort to get patients enrolled in hospice very soon after admission. This also means, for example, if a patient is discharged to hospice and then readmitted within 30 days, the patient is excluded from the denominator for mortality calculations for that readmission visit (5).

The assignment of MS-DRGs is also an area where further study is warranted. The reduced likelihood of having a higher-level MS-DRG assigned to geriatric patients, when compared to younger patients, is a potential gap and opportunity for improvement.

Another opportunity for expanding on this study is to analyze the data with methodology that incorporates matching of patients and/or hospitals in order to get a more refined comparison of coding practices.

Conclusion

The healthcare environment has changed over the past decade with increased focus on quality and patient outcomes. Public reporting and pay-for-performance programs such as CMS' Value-Based Purchasing impact hospitals financially through incentives and penalties; public reporting could have an impact on consumer choice. The majority of metrics with which hospitals are being evaluated are based on medical coding and documentation; therefore, it is imperative that the coding and documentation accurately depicts the patient's characteristics and conditions.

This study attempted to evaluate the potential influence of coding practices on hospital rankings by examining the use of the palliative care code (V66.7) in adult patients with severe sepsis. It also examined the ways in which severe sepsis was coded and the frequency with which higher-level MS-DRGs were assigned. It was revealed that low-performing hospitals, those hospitals who fell in the fourth quartile of mortality indices (observed mortality/expected mortality) were less likely to have a code for palliative care when compared to high-performing hospitals (Quartile 1). The findings support the basic premise that coding for palliative care is associated with better mortality rankings. The underlying explanations for these findings are associated with discharge disposition, particularly discharges to hospice care. High performing hospitals had higher rates of discharges to hospice and lower rates of inpatient deaths when compared to the lower performing hospitals.

Patients who were discharged to hospice care had higher odds of receiving this code when compared to patients who died in-hospital. This suggests that opportunities for documentation or coding may be missed when a patient dies in-hospital without a formal consultation by a palliative care service or referral to hospice service. This warrants further examination incorporating medical record review as coding itself does not reveal the nature of the palliative code (i.e. does it reflect a formal palliative care service consultation versus an order for comfort care in absence of a consult). Improvements in provider documentation, coding processes, and increased access to hospice care could help hospitals improve their mortality rate rankings.

The manner of coding severe sepsis did not have significant results; there were no significant differences between the higher- (Quartile 1) and lower- (Quartile 4) performing hospitals. A similar finding occurred during the examination of MS-DRG assignment. Intraquartile analyses of MS-DRG assignment did reveal some interesting patterns, such as patients in older age groups having a smaller likelihood of getting a higher MS-DRG assigned. This also necessitates further analyses utilizing medical record audits to identify underlying documentation and coding patterns and potential opportunities for improvement.

The long-term viability of hospitals depends on complete and accurate coding and documentation. Hospitals are reimbursed based on coding and are being compared to one another based on quality metrics and patient outcomes that also depend on coding. There are financial implications through CMS programs based on these comparisons. Hospitals' performance is reported publically and patients may use these in their decisions for healthcare providers. It is hoped that this study contributes to the conversation about areas of opportunities for leveling the playing field when addressing

APPENDIX A: Search Methodology

Search #	Search String	Results	Excluded	Yield
n/a	*(mortality rate) AND palliative care*	*9214**	*0*	*0*
1	((mortality rate) AND palliative care) AND risk adjustment	45	41	4
n/a	*hospital standardized mortality ratio*	*1225**	*0*	*0*
2	(hospital standardized mortality ratio) AND coding	11	6	5
4	((mortality) AND palliative care) AND coding	13	7	6
5	((mortality) AND palliative care) AND code	27	22	5
6	((mortality) AND risk adjust) AND reporting	42	36	6
7	((mortality) AND risk adjustment) AND reporting	285	222	63
8	((mortality) AND risk adjustment) AND metrics	46	31	15
9	(mortality) AND pay for performance	216	137	79
10	mortality AND value based purchasing	23	15	8
11	(mortality) AND risk adjustment) AND pay for performance	21	2	19
12	(mortality) AND risk adjustment) AND value based purchasing	2	0	2
13	((pay for performance) AND mortality) AND effects	37	22	15
14	((value based purchasing) AND mortality) AND effects	4	2	2
15	((Mortality) AND CMS) AND risk adjustment	19	9	10
16	((Mortality) AND financial incentive) AND risk adjustment	12	0	12
17	((mortality) AND risk adjustment) AND benchmarking	124	56	68
18	((mortality) AND risk adjustment) AND palliative care	45	41	4
19	((mortality) AND severe sepsis) AND benchmarking	32	26	6
20	((risk adjusted mortality) AND severe sepsis) AND benchmarking	2	1	1
21	((severe sepsis) AND mortality) AND risk adjustment	245	210	35
n/a	*((mortality) AND quality) AND reporting*	*2009**	*0*	*0*
n/a	*limit to 10 years (2005 -2015)*	*1556**	*0*	*0*
22	((risk adjusted mortality) AND quality) AND reporting	187	152	35
23	(((mortality) AND public reporting) AND methodology) and documentation	35	35	0
n/a	Mortality AND public reporting	1769*	0	0
24	((mortality) AND public reporting) AND risk adjustment	82	58	24
	Total	**1555**	**1131**	**424**

Initial search string; searches modified due to high yield

APPENDIX B: ICD-9-CM Codes for Bacterial and Fungal Infections

Code	Description
001	Cholera
002	Typhoid/paratyphoid fever
003	Other salmonella infection
004	Shigellosis
005	Other food poisoning
008	Intestinal infection not otherwise classified
009	Ill-defined intestinal infection
010	Primary tuberculosis infection
011	Pulmonary tuberculosis
012	Other respiratory tuberculosis
013	Central nervous system tuberculosis
014	Intestinal tuberculosis
015	Tuberculosis of bone and joint
016	Genitourinary tuberculosis
017	Tuberculosis not otherwise classified
018	Miliary tuberculosis
020	Plague
021	Tularemia
022	Anthrax
023	Brucellosis
024	Glanders
025	Melioidosis
026	Rat-bite fever
027	Other bacterial zoonoses
030	Leprosy
031	Other mycobacterial disease
032	Dipththeria
033	Whooping cough
034	Streptococcal throat/scarlet fever
035	Erysipelas
036	Meningococcal infection
037	Tetanus
038	Septicemia
039	Actinomycotic infections
040	Other bacterial diseases
041	Bacterial infection in other diseases not otherwise specified
090	Congenital syphilis
091	Early symptomatic syphilis

APPENDIX B: ICD-9-CM Codes for Bacterial and Fungal Infections (continued)

Code	Description
092	Early syphilis latent
093	Cardiovascular syphilis
094	Neurosyphylis
095	Other late symptomatic syphilis
096	Late syphilis latent
097	Other and unspecified syphilis
098	Gonococcal infections
100	Leptospirosis
101	Vincent's angina
102	Yaws
103	Pinta
104	Other spirochetal infection
110	Dermatophytosis
111	Dermatomycosis not otherwise classified or specified
112	Candidiasis
114	Coccidioidomycosis
115	Histoplasmosis
116	Blastomycotic infection
117	Other mycoses
118	Opportunistic mycoses
320	Bacterial meningitis
322	Meningitis, unspecified
324	Central nervous system abscess
325	Phlebitis of intracranial sinus
420	Acute pericarditis
421	Acute or subacute endocarditis
451	Thrombophlebitis
461	Acute sinusitis
462	Acute pharyngitis
463	Acute tonsillitis
464	Acute laryngitis/tracheitis
465	Acute upper respiratory infection of multiple sites/not otherwise specified
481	Pneumococcal pneumonia
482	Other bacterial pneumonia
485	Bronchopneumonia with organism not otherwise specified
486	Pneumonia, organism not otherwise specified
491.21	Acute exacerbation of obstructive chronic bronchitis
494	Bronchiectasis
510	Empyema

APPENDIX B: ICD-9-CM Codes for Bacterial and Fungal Infections (continued)

Code	Description
513	Lung/mediastinum abscess
540	Acute appendicitis
541	Appendicitis not otherwise specified
542	Other appendicitis
562.01	Diverticulitis of small intestine without hemorrhage
562.03	Diverticulitis of small intestine with hemorrhage
562.11	Diverticulitis of colon without hemorrhage
562.13	Diverticulitis of colon with hemorrhage
566	Anal and rectal abscess
567	Peritonitis
569.5	Intestinal abscess
569.83	Perforation of intestine
572.0	Abscess of liver
572.1	Portal pyemia
575.0	Acute cholecystitis
590	Kidney infection
597	Urethritis/urethral syndrome
599.0	Urinary tract infection not otherwise specified
601	Prostatic inflammation
614	Female pelvic inflammation disease
615	Uterine inflammatory disease
616	Other female genital inflammation
681	Cellulitis, finger/toe
682	Other cellulitis or abscess
683	Acute lymphadenitis
686	Other local skin infection
711.0	Pyogenic arthritis
730	Osteomyelitis
790.7	Bacteremia
996.6	Infection or inflammation of device/graft
998.5	Postoperative infection
999.3	Infectious complication of medical care not otherwise classified

APPENDIX C : ICD-9-CM Codes for Acute Organ Dysfunction (Angus, et al, 2001)

Code	Description	Organ System
785.5	Shock without trauma	Cardiovascular
458	Hypotension	Cardiovascular
96.7	Mechanical Ventilation	Respiratory
588	Respiratory failure	Respiratory
786.03	Apnea	Respiratory
799.1	Respiratory Arrest	Respiratory
348.3	Encephalopathy	Neurologic
293	Transient organic psychosis	Neurologic
348.1	Anoxic brain damage	Neurologic
287.4	Secondary thrombocytopenia	Hematologic
287.5	Thrombocytopenia, unspecified	Hematologic
286.9	Other/unspecified coagulation defect	Hematologic
286.6	Defibrination syndrome	Hematologic
570	Acute and subacute necrosis of live	Hepatic
573.4	Hepatic infarction	Hepatic
584	Acute renal failure	Renal

APPENDIX D: Palliative Care Code Usage—Focus Population (Quartile 1 vs. Quartile 4)

	Quartile 1			Quartile 4			
Variable	**Total**	**V66.7**	**%**	**Total**	**V66.7**	**%**	**P-Value**
Gender							
Male	9883	1548	15.66	7578	1289	17.01	0.02
Female	8991	1329	14.78	6866	1206	17.56	<0.0001
Age Group							
18-44 years	2129	144	6.76	1798	169	9.40	0.002
45 to 65 years	6678	859	12.86	5084	790	15.54	<0.0001
66 to 84 years	8363	1484	17.74	6194	1212	19.57	0.005
85 years and older	1704	390	22.89	1368	324	23.68	0.60
Race							
White	13370	2064	15.44	7827	1413	18.05	<0.0001
Black	3593	533	14.83	3673	586	15.95	0.19
Asian	290	46	15.86	672	134	19.94	0.14
Other	1211	160	13.21	2046	327	15.98	0.03
Unknown/unavail/declined	410	74	18.05	226	35	15.49	0.41
Ethnicity							
Hispanic	1008	131	13.00	1217	195	16.02	0.04
Not Hispanic	12857	2096	16.30	8321	1474	17.71	.007
Unknown/Unavail/Declined/Missing	5009	650	12.98	4906	826	16.84	<0.0001
Payer Type							
Commercial	3273	423	12.92	2212	336	15.19	0.02
County/State Assistance	94	10	10.64	138	21	15.22	0.31
Medicaid	2629	268	10.19	2509	363	14.47	<0.0001
Medicare	12164	2082	17.12	8754	1652	18.87	0.001
Other	303	48	15.84	406	75	18.47	0.36
Uninsured	411	46	11.19	425	48	11.29	0.96
Admission Source							
Non-facility Point of Origin	15749	2236	14.20	12712	2109	16.59	<0.0001
Clinic/Physician referral	1316	236	17.93	571	107	18.74	0.68
Transfer from SNF or ICF	1342	314	23.40	916	230	25.11	0.35
Transfer from another facility	416	86	20.67	210	45	21.43	0.83
Court/Law enforcement	51	5	9.80	35	4	11.43	0.81
ED Flag Code							
No	1232	240	19.48	1595	254	15.92	0.01
Yes	14920	2184	14.64	10794	1858	17.21	<0.0001
Missing	2722	453	16.64	2055	383	18.64	0.07

Technical Note: Categorical variables analyzed using chi-square tests.significance measured at $\alpha = 0.05$ level.

APPENDIX D: Palliative Care Code Usage—Focus Population (Quartile 1 vs. Quartile 4) (Continued)

	Quartile 1			Quartile 4			
Variable	**Total**	**V66.7**	**%**	**Total**	**V66.7**	**%**	**P-Value**
Readmission							
No	15862	2702	17.03	12405	2384	19.22	<0.0001
Yes	3012	175	5.81	2039	111	5.44	0.58
Discharge Disposition							
Expired	2798	1428	51.04	4002	1732	43.28	<0.0001
Home	5119	59	1.15	3784	85	2.25	0.0001
Home health	3194	84	2.63	1972	60	3.04	0.38
Hospice (home or medical facility)	1601	1005	62.77	638	375	58.78	0.08
LTCH	798	43	5.39	411	23	5.60	0.88
Other Facility	263	19	7.22	144	11	7.64	0.88
Skilled Nursing Facility/Rehabilitation	5101	239	4.69	3493	209	5.98	0.01
ICU Stay							
No	6366	682	10.71	5400	748	13.85	<0.0001
Yes	12492	2195	17.57	8935	1728	19.34	0.001
MSDRG Type							
Medical	15711	2472	15.73	11709	2065	17.64	<0.0001
Surgical	3163	405	12.80	2735	430	15.72	0.001
Severe Sepsis Diagnosis Scheme							
Severe Sepsis without Shock	10241	1200	11.72	7376	1062	14.40	<0.0001
Severe Sepsis with Shock	8633	1677	19.43	7068	1433	20.27	0.18

Technical Note: Categorical variables analyzed using chi-square tests; significance measured at $\alpha = 0.05$ level.
MS-DRG: Medicare Severity-Diagnosis Related Group

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