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Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study

Association of Nurse Staffing and Education with Hospital Mortality in 9 European Countries

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Ethical approval: The European study protocol received ethical approval by the lead university, Catholic University of Leuven, Belgium. Each grantee organisation in the 9 participating countries received ethical approval at the institutional level to conduct nurse surveys and analyse administrative data on patient outcomes. We also obtained country level approvals to acquire and analyse patient outcomes data.

Abstract

Background: Austerity measures and health system redesign to contain hospital expenditures risk adversely affecting patient outcomes. RN4CAST was designed to inform decision-making about nursing, one of the largest components of hospital operating expenses.

Methods: Discharge data were obtained for patients aged 50 or older that underwent common surgeries in 300 hospitals in 9 countries in Europe (N=422,730 patients). Administrative data were coded following a standard protocol using variants of 9th or 10th versions of the International Classification of Diseases (ICD) to estimate 30-day in-hospital mortality using risk adjustment measures including age, sex, admission type, 43 dummy variables indicating surgery type, and 17 dummy variables indicating co-morbidities present on admission which are included in the Charlson index. Surveys of 26,516 nurses practicing in study hospitals were used to measure nurse staffing and nurse education. Generalized estimating equations analyzed effects of nursing factors on likelihoods of surgical patients dying within 30 days of admission, before and after adjusting for other hospital and patient characteristics.

Findings: Increase in nurses' workloads of one patient increases the odds on inpatient hospital mortality by 7%, and every 10% increase in bachelor's degree nurses is associated with a decrease in odds on mortality by 7%. These associations imply that patients in hospitals in which 60% of nurses had bachelor's degrees and nurses cared for an average of 6 patients would have almost 30% lower mortality than patients in hospitals in which only 30% of nurses had bachelor's degrees and nurses cared for an average of 8 patients.

Interpretation: Hospitals in which nurses care for fewer patients each and which have a higher proportion of bachelor's prepared nurses have lower mortality after common surgeries. Reductions in staffing to save money may adversely affect patient outcomes while moving to bachelor's prepared nurses holds promise for reducing preventable hospital deaths.

(Words: 300)

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Association of Nurse Staffing and Education with Hospital Mortality in 9 European Countries

Introduction

Constraining health expenditure growth remains an important policy objective in Europe despite concerns about adverse outcomes for quality and safety of health care.[1,2] Hospitals are a target for spending reductions. Health system reforms have shifted resources to provide more care in community settings while shortening hospital length of stay and reducing inpatient beds resulting in higher care intensity for inpatients. The possible combination of fewer trained staff in hospitals and more intensive patient interventions raises concerns about whether quality of care might deteriorate. The European Surgical Outcomes Study across 28 countries recently documented higher than expected hospital surgical mortality and significant country variation in hospital outcomes.[3]

Nursing is a "soft" target because savings can be realized quickly by reducing nurse staffing whereas achieving real "productivity" gains is difficult. The consequences of trying to do more with less is illustrated in England's Francis Report[4] which discusses how nurses came under fire for failing to prevent poor care after nurse staffing was reduced to meet financial targets. Similarly, the Keogh review[5] of 14 hospital trusts in England that had persistently high mortality rates identified inadequate nurse staffing as a significant factor. Austerity measures in Ireland and Spain have likewise been described as adversely affecting hospital staffing.[6,7]

Research that could potentially guide policies and practices on safe hospital nurse staffing in Europe has been limited. Jarman and colleagues documented higher mortality in hospitals in England associated with larger proportions of auxiliary nurses which implies a lower overall nursing skill mix.[8] Rafferty and colleagues showed that lower hospital mortality in England following common surgeries was associated with nurses caring for fewer patients each.[9] Research in Belgium found hospital mortality after cardiac surgery was significantly lower in hospitals with better nurse to patient staffing ratios and in hospitals with a higher proportion of nurses with bachelor's education.[10] Likewise, a Swiss study documented significantly higher surgical mortality associated with inadequate nurse staffing and poor nurse work environments.[11]

This nascent but growing nursing outcomes research literature in Europe is complemented by research from North America showing consistently that better hospital nurse staffing is associated with lower mortality.[12] A growing literature also suggests that bachelor's education for nurses is associated with lower hospital mortality.[13-17]

Research on nursing has had limited policy traction in Europe compared, for example, to the United States where almost half the 50 states have implemented or are considering hospital nurse staffing legislation.[18-19] On the basis of research showing better outcomes for patients, the Institute of Medicine recommended that the U.S. move to 80% bachelor's degree nurses by 2020,[20] and hospitals have responded with preferential hiring of bachelor's nurses. European decision-makers may be unclear about the applicability of research conducted in single countries in Europe or in North America to Europe more generally. Specifically, scientific evidence is needed to inform the ongoing European Union policy debate about harmonizing professional qualifications for nurses.[21]

RN4CAST, funded by the European Commission, was designed to provide scientific evidence for decision-makers in Europe about how to get the best value for nursing workforce investments, and to guide workforce planning to produce a nurse workforce for the future that would meet population health needs.[22] The study of 488 hospitals in 12 European countries documented substantial variation between countries in patient to nurse workloads, and in the percentage of nurses qualified at the bachelor's level.[23] These variations in nursing resources have been shown to be important predictors of patients' satisfaction with their care and in nurses' assessments of quality and safety of care.[24]

Here we examine whether differences in patient to nurse workloads and nurses' educational qualifications in 9 of the 12 RN4CAST countries with comparable patient discharge data are associated with variation in hospital mortality following common surgical procedures. The 9 countries reflect variation in Europe with respect to organization, financing, and resources devoted to health services. The study's findings provide previously unavailable evidence to guide important decisions about improving hospital care in Europe in a context of limited resources and health system reforms.

Methods

Study setting

Data are from administrative sources on hospital patients and characteristics of hospitals, and surveys of 26,516 bedside care professional nurses conducted in 2009-2010 in 300 hospitals in nine European countries (Belgium, England, Finland, Ireland, the Netherlands, Norway, Spain, Sweden, and Switzerland). Comparable patient discharge data that were consistent with the patient mortality protocol were not available for three RN4CAST countries (Germany, Poland, and Greece). Most adult acute care hospitals in Sweden, Norway, and Ireland, and geographically representative samples of hospitals in the other countries were included.[22]

Outcome measures

Patient mortality data were obtained for post-operative patients discharged from study hospitals in the year most proximate to the nurse survey for which data were available, which ranged across countries from 2007 to 2009. Our analyses included patients aged 50 years or older with a hospital stay of at least two days that underwent common general, orthopedic, or vascular surgery, and for whom complete data were available on comorbidities present on admission, surgery type, discharge status, and other variables used for risk adjustment (N=422,730). Definitions of common surgeries and co-morbidities (see Appendix Table 1) followed the procedures published by Silber.[25] Common surgeries were selected for study because 1) almost all acute hospitals undertake them, 2) risk adjustment procedures for surgical patients have been well-validated, and 3) risk-related co-morbidities can be more accurately distinguished for surgical patients than for medical patients as present on admission in contrast to complications occurring in the hospital. Data were coded in all countries following a standard protocol and using variants of the 9th or 10th version of the International Classification of Diseases (ICD).[26] Research in Europe shows that routinely collected administrative data predict risk of hospital death with discrimination comparable with that obtained from clinical databases.[27] Hospitals were limited to those with 100 or more targeted patients. The primary outcome measure was whether patients died in the hospital within 30-days of admission. Risk adjustment variables included patient age, sex, admission type (emergency/elective), 43 dummy variables indicating surgery type, and

17 dummy variables indicating co-morbidities present on admission, which are included in the Charlson index.[28]

Nurse measures

Nurse staffing and education measures were derived from responses to surveys of nurses in each hospital using a common instrument. The term nurse refers to fully qualified professional nurses. In all countries except Sweden, hospitals were sampled in different regions, after which adult medical and surgical wards were randomly sampled in each hospital, and all nurses providing direct patient care in these wards were surveyed. In Sweden, all hospitals were included by sampling all medical-surgical nurses nationally. Response rates ranged from just under 40% in England to nearly 84% in Spain and averaged 63% across the nine countries.

Nurse staffing was calculated for each hospital from survey data by dividing the number of patients by the number of nurses that each nurse reported were present on their ward on their last shift, and then averaging ratios across all nurse respondents in each hospital. Lower ratios indicate more favorable staffing. Collecting data on hospital nurse staffing directly from nurses avoids differences in administrative reporting methods across countries and ensures that only nurses in inpatient care roles are being counted. Nurse education was measured by calculating the percentage of all nurses in each hospital that reported that the highest academic qualification they had earned was a bachelor's degree or higher.

Analyses

We estimate associations between nurse staffing and nurses' education and 30-day inpatient mortality for patients before and after adjusting for additional hospital characteristics and risk-adjusting for differences in patient characteristics. Hospital characteristics include country, bed size, teaching status, and technology, with high technology hospitals defined as those that undertake open heart surgery and/or organ transplantation. The hospital nurse work environment, measured by the Practice Environment Scale of the Nursing Work Index, was included as a control variable as in previous research on nursing and mortality.[15] Patient characteristics included age, sex,

admission type, type of surgery (using 43 dummy variables for the specific surgery types), and presence of 17 co-morbidities (listed in Appendix Table 1). Since individual patient outcomes were modeled using a combination of hospital and patient characteristics, we estimated the effects of different characteristics with 1) population average models using a generalized estimating (GEE) approach, and 2) random intercepts models using hierarchical linear modeling (HLM). Both approaches take account of patients being nested within hospitals, and in both types of models we included dummy variables to allow for unmeasured differences across countries. Because the results were virtually identical, and the estimated effects of nursing characteristics were the same in terms of their size and significance, we show only the GEE results. We tested for the effects on mortality of an interaction between nurse staffing and education, which was not significant and is not included in the results.

Results

Table 1 shows that the number of hospitals ranged from 16 in Spain to 62 in Sweden, and the number of surgical discharges varied across countries from slightly less than 20,000 in Ireland to more than 88,000 in Belgium. The average number of discharges per hospital ranged from over 700 in Ireland to over 2,600 in England, and within each country there were often 10-fold or more differences in numbers of discharges across hospitals. The percentage of surgical patients that died in the hospital within 30 days of admission was 1.3% across the nine countries combined, and varied from 1% in Sweden to 1.5% in Ireland, the Netherlands, Norway, and Switzerland.

Table 2 shows averages and ranges in nurse staffing and nurse education across study hospitals in each of the nine countries, and overall. Differences in both nurse staffing and nurse education were considerable both across countries and across hospitals within each country. The number of patients per nurse averaged 5.2 in the 28 hospitals in Norway (and ranged across hospitals from 3.4 to 6.7), while it averaged 12.7 in the 16 hospitals in Spain (and varied across hospitals from 9.5 to 17.9). In Switzerland, hospitals on average had 10% of their nurses with bachelor's degrees, and the percent of nurses with bachelor's degrees ranged from 0% to 39%. In Belgium, hospitals on average had 55% of their nurses with bachelor's degrees, and the percent of nurses with bachelor's

degrees ranged from 26% to 86%. In Spain and Norway all nurses had bachelor's degrees.

Table 3 shows the mean age of the patient sample was 68 years (SD = 10) and 45% were men. Of 439,800 patients studied, just over half had orthopedic surgeries, while roughly 4 in 10 underwent general surgeries, and slightly less than one in 10 underwent vascular surgeries. The most common comorbidities were diabetes without complications (8%), chronic pulmonary disease (7%), metastatic carcinoma (4%) and cancer (4%).

Table 4 shows results of modeling the effects of the two nursing factors (staffing and education) on mortality after adjusting for differences across countries in mortality (in the partially adjusted model) and for differences in the full set of potentially confounding factors (in the fully adjusted model). The odds ratios from the partially adjusted models indicate the effects of nurse staffing and nurse education on mortality when the effects of those factors are considered one at a time and only dummy variables for country are included in the models. In the fully adjusted model those two effects are estimated simultaneously with controls for country and for the other hospital and patient characteristics.

After considering severity of illness of the patients and characteristics of the hospitals including teaching status and technology in the adjusted model, both nurse staffing and nurse education are significantly associated with mortality. The odds ratios suggest that each increase of one patient per nurse is associated with a 7% increase in the odds on surgical patients dying within 30 days of admission, while each 10% increase in the percent of bachelor's degree nurses in a hospital is associated with a 7% decrease in those odds. These associations imply that patients in hospitals in which 60% of the nurses had bachelor's degrees and nurses cared for an average of 6 patients would have almost 30% lower mortality than patients in hospitals in which only 30% of the nurses had bachelor's degrees and nurses cared for an average of 8 patients. This 30% reduction, or reduction in mortality by a factor of 0.70, is obtained by applying (and multiplying) the reciprocal of the odds ratio associated with nurse staffing from Table 4 across two intervals (from 8 to 6 patients per nurse) and the odds ratio associated with nurse

education across three intervals (from 60% to 30%); i.e., 1/1.068 x 1/1.068 x 0.929 x 0.929 x 0.929 = 0.703.

Discussion

The RN4CAST study found more variation in hospital mortality following common surgical procedures in European hospitals than is generally understood or might be judged acceptable by the public. Variation in hospital mortality is associated with differences in nurse staffing levels and nurses' educational qualifications. Hospitals where nurses cared for fewer patients each and a higher proportion had bachelor's degrees had significantly lower mortality. The sizes of these associations are very similar to findings for surgical patients in U.S. and Canadian hospitals in studies using similar measures and following similar protocols.[14,15]

Our finding that each 10% increase in the proportion of nurses with a bachelor's degree in hospitals is associated with a 7% decline in mortality is highly relevant to the recent decision of the European Parliament (October 9, 2013) to endorse two educational tracks for nurses—one vocational and one higher education.[21] The goal of standardizing qualifications of professionals as expressed in the Bologna process has a long way to go in the case of nursing, as RN4CAST documents that nurse educational qualifications vary substantially by country across Europe. Our findings support the recent EU decision to recognize professional nursing education within institutions of higher education commencing after 12 years of general education. But our study challenges the decision to continue to endorse vocational nursing education following only 10 years of general education, as this may be hampering access to higher education for nurses in some countries. Germany is a case in point as the RN4CAST study of 49 German hospitals did not identify a single nurse with a baccalaureate degree.[23]

RN4CAST findings that better hospital nurse staffing is associated with lower risk of mortality may be inconvenient in the current difficult financial context and amidst health system reforms to shift resources to community-based settings. Nevertheless it is a robust research finding in what we believe is the largest and most rigorous study ever undertaken of nursing and hospital outcomes in Europe. Our findings reinforce those of smaller studies in Europe,[8-11] and a very substantial international research literature.[12,14]

The results reported here suggest that maintaining a safe level of hospital nurse staffing is an example of an evidence-based intervention that may help reduce surgical mortality, as called for by the European Surgical Outcomes Study.[3]

Beyond improvements in care, investments in nursing may make good business sense. In the U.S. context, each $1 spent on nurse staffing improvements was estimated to return a minimum of $ .75 economic benefit to the investing hospital, not counting intangible benefits.[29] Furthermore, contrary to conventional wisdom, converting less qualified licensed vocational nurse hours to qualified professional nurse hours was estimated to save lives and money.[30] Better nurse staffing in U.S. hospitals is associated with significantly lower readmission rates which is compelling given financial penalties in 2013 to 2,225 hospitals for excessive readmissions.[31] While the particulars of hospital finance and payment policies differ between the U.S. and Europe, the underlying goal of obtaining better value for investments is the same.[32]

Our study has several limitations. We examined one outcome, mortality, and only among patients undergoing common general surgeries. Our measure of education relies on each country's definition of bachelor's education for nurses which differs by country. Our global measure of nurse staffing reflects nurse workloads across all shifts, and may be skewed in some hospitals if nurses working at night when patient to nurse ratios are higher responded to our survey at different rates than nurses on day shifts. The models we used to measure associations allowed us to control for unmeasured differences in mortality across countries as well as for measured differences across patients and hospitals, but there may be unmeasured confounding individual, hospital, and community factors that could affect our results. We cannot link the care of individual patients to individual nurses. Also mortality outcomes for patients were from the year that most closely matched the nurse survey year, but because of patient data availability lags, the two data sources were not in all cases perfectly aligned. Finally, our data are cross-sectional and provide limited information about causality.

Additional research in Europe will be required to determine whether our multi-country findings can be replicated for higher mortality surgeries and for medical patients. Future research will be needed to determine whether in Europe, as in the U.S., nursing is related to a range of non-mortality outcomes that contribute to higher costs. Longitudinal

studies of panels of hospitals would be particularly valuable in helping to determine causal relationships between changes in nursing resources and outcomes for patients. Comparative effectiveness research is needed to determine which workforce investments and under what circumstances return the greatest value. Research beyond simple mortality outcomes would be welcome to help establish standards of care by which performance of health care organizations could be more fully evaluated. In a context of widespread health system redesign and reforms, increased research funding for studies of health workforce investments could result in new knowledge that would help point the way to high value health care.

In summary, educational qualifications of nurses and patient to nurse staffing ratios appear to matter in the outcomes of hospitalized patients in Europe. Previous research from RN4CAST shows that patients are more likely to express satisfaction with hospital care when nurses care for fewer patients each. [24] Here, our findings, if replicated, suggest that evidence-based investments in nursing may be associated with fewer hospital deaths as well.

Words: 3001

Panel: Research in Context

Systematic review

This study evaluated whether differences in patient to nurse workloads and nurses' educational qualifications in 9 of the 12 RN4CAST countries with comparable patient discharge data are associated with variation in hospital mortality following common surgical procedures. We searched PubMed for original research published in English between January 1, 1985 and August 10, 2013, with the search terms (separately and in combination) "nursing", "staffing", "administrative data", "outcomes", "mortality", "European Union", and "cross-national" and "inter-national." We also conducted a manual search based on bibliographies of papers we found. Studies linking nursing and clinical patient outcomes were limited in Europe to single country studies[8-11] and to

research in North America.[12-17] In Europe, cross-national studies examining how hospital nursing affects patient outcomes have been limited to examining outcomes based on patient or nurse report rather than objective clinical outcomes.[24]

Interpretation

This is the first study using detailed information on nursing workforce such as staffing and education level to evaluate how these conditions affect patient mortality across countries in Europe. We relied on unique data from direct-care nurses collected using a common methodology across large numbers of hospitals in multiple countries. A standardized approach across countries was employed for measuring and risk adjusting mortality based on administrative records. Our analysis of 300 hospitals in 9 countries shows that an increase in nurses' workloads of one patient increases the odds on inpatient hospital mortality by 7%, and a 10% increase in bachelor's degree nurses is associated with a decrease in odds on mortality by 7%. These findings highlight the risk to patients that could emerge in response to nurse staffing cuts and suggest that an increased emphasis on bachelor's education for nurses may hold promise for reducing preventable hospital deaths.

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Table 1. Numbers of Hospitals Sampled in Nine European Countries with Patient Discharge Data, Numbers of Surgical Patients Discharged, and Numbers of Patient Deaths (RN4CAST Data)

Country	Hospitals	Discharges	Average Discharges/ Hospital	Minimum	Maximum	Deaths/ Discharges	Percent Deaths
Belgium	59	88078	1493	413	4794	1017/88078	1.15
England	30	78045	2603	868	6583	1084/78045	1.39
Finland	25	27867	1516	175	3683	303/27867	1.09
Ireland	27	19822	738	103	1997	292/19822	1.47
Netherlands	22	31216	1419	181	2994	466/31216	1.49
Norway	28	35195	1468	432	4430	518/35195	1.47
Spain	16	21520	1382	186	3034	283/21520	1.32
Sweden	62	80800	1304	295	4654	828/80800	1.02
Switzerland	31	40187	1308	158	3812	590/40187	1.47
Total	300	422730	1308	103	6583	5381/422730	1.27

Notes: Only hospitals with more than 100 surgical patient discharges were included in the analyses. Data shown are for discharged patients for whom information on 30-day mortality, age, sex, type of surgery, and comorbidities, are complete. Data were missing on those characteristics for less than four percent of all patients.

Table 2. Hospital Averages and the Range of Values for Nurse Staffing and Nurse Education Across Hospitals in Each of the Nine Countries, and Overall

	Nurse Staffing (Patients/Nurse)		Nurse Education (Percent of Nurses with Baccalaureate Degrees)	
Country	**Mean (SD)**	**Range**	**Mean (SD)**	**Range**
Belgium	10.8 (2.0)	7.5-15.9	55 (15)	26-86
England	8.8 (1.5)	5.5-11.5	28 (9)	10-49
Finland	7.6 (1.4)	5.3-10.6	50 (10)	36-71
Ireland	6.9 (1.0)	5.4-8.9	58 (12)	35-81
Netherlands	7.0 (0.8)	5.1-8.1	31 (12)	16-68
Norway	5.2 (0.8)	3.4-6.7	100 (0)	100-100
Spain	12.7 (2.0)	9.5-17.9	100 (0)	100-100
Sweden	7.6 (1.1)	5.4-9.8	54 (12)	27-76
Switzerland	7.8 (1.3)	4.6-9.8	10 (10)	0-39
TOTAL	8.3 (2.4)	3.4-17.9	52.1 (27.2)	0-100

Note: Means, standard deviations and ranges are estimated from hospital level data. (e.g., The 59 hospitals in Belgium have a mean patient/nurse ratio of 10.8, and the patient/nurse ratio ranges across those 59 hospitals from 7.5 to 15.9. Similarly, the 31 hospitals in Switzerland have, on average, 10% BSN nurses, and the percent of BSN nurses ranges across those 31 hospitals from 0% to 39%).

Table 3. Characteristics of Surgical Patients (n = 422,730) in the Study Hospitals

Characteristic	Mean (Median)	Interquartile Range
Age in Years (SD)	67.9 (68.0)	60 - 76
	n	**%**
Male	189815	44.9%
Emergency admissions	141584	33.5%
Inpatient Deaths within 30 days of admission	5381	1.3%
Surgical Categories		
General Surgery	162974	38.6%
Orthopedic Surgery	220301	52.1%
Vascular Surgery	39455	9.3%
Comorbidities		
Cancer	15297	3.6%
Cerebrovascular Disease	7400	1.8%
Congestive Heart Failure	10274	2.4%
Chronic Pulmonary Disease	28373	6.7%
Dementia	5744	1.4%
Diabetes with complications	6478	1.5%
Diabetes without complications	35450	8.4%
AIDS/HIV	50	0.0%
Metastatic Carcinoma	17911	4.2%
Myocardial Infarction	12002	2.8%
Mild Liver Disease	5953	1.4%
Moderate or Severe Liver Disease	1354	0.3%
Paraplegia and Hemiplegia	2043	0.5%
Peptic Ulcer Disease	2323	0.5%
Peripheral Vascular Disease	12452	2.9%
Renal Disease	10085	2.4%
Connective Tissue Disease - Rheumatic Disease	6962	1.6%

Table 4. Partially and Fully Adjusted Odds Ratios Indicating the Effects of Nurse Staffing and Nurse Education on 30-Day Inpatient Mortality

Nursing Factor	Partially Adjusted Models		Fully Adjusted Model	
	O.R. (95% C. I.)	Pr > |z|	O.R. (95% C. I.)	Pr > |z|
Staffing	1.005 (0.965-1.046)	0.816	1.068 (1.031-1.106)	<.001
Education	1.000 (0.959-1.044)	0.990	0.929 (0.886-0.973)	0.002

Note: The partially adjusted models estimate the effects nurse staffing and nurse education separately while controlling for unmeasured differences across countries. The fully adjusted model estimates the effects nurse staffing and nurse education simultaneously, controlling for unmeasured differences across countries and for the hospital characteristics (bed size, teaching status, technology, and work environment) and patient characteristics (age, sex, admission type, type of surgery, and co-morbidities present on admission) described in the text.

Appendix Table 1. Surgical Procedure Codes and Comorbidities Used for Risk Adjustment

Surgical Procedures and Comorbidities	CMS DRG Equivalent
General Surgery	
Rectal Resection and Major Small & Large Bowel Procedure	146,147,148,149
Peritoneal Adhesiolysis	150,151
Minor Small & Large Bowel Procedure	152,153
Stomach, Esophageal & Duodenal Procedure	154,155
Anal & Stomal Procedure	157,158
Hernia Procedure except Inguinal & Femoral	159,160
Inguinal & Femoral Hernia Procedure	161,162
Appendectomy	164,165,166,167
Other Digestive System Procedure	170,171
Pancreas, Liver & Shunt Procedure	191,192
Biliary Tract Procedure except Only Cholecystectomy	193,194
Cholecystectomy except by Laparoscope	195,196,197,198
Hepatobiliary Diagnostic Procedure or Other Hepatobiliary or Pancreas Procedure	199,200,201
Total or Subtotal Mastectomy for Malignancy	257,258,259,260
Skin Graft &/or Debridement for Skin Ulcer or Cellulitis	263,264
Skin Graft &/or Debridement except for Skin Ulcer or Cellulitis	265,266
Amputation of Lower Limb for Endocrine, Nutritional, & Metabolic Disorders	285
Adrenal & Pituitary Procedure	286
Skin Grafts & Wound Debridement for Endocrine, Nutrition, & Metabolic Disorder	287
Procedure for Obesity	288
Other Endocrine, Nutrition & Metabolic Procedure	292,293
Laparoscopic Cholecystectomy	493,494
Orthopedic Surgery	
Major Joint & Limb Reattachment Procedure of Lower Extremity	209
Hip & Femur Procedure except Major Joint	210,211
Amputation for Musculoskeletal System & Connective Tissue Disorders	213
Biopsies of Musculoskeletal System & Connective Tissue	216
Wound Debridement & Skin Graft except Hand	217
Lower Extremity & Humerus Procedure except Hip, Foot, Femur	218,219
Upper Extremity Procedures	223,224,491
Foot Procedure	225
Soft Tissue Procedure	226,227
Local Excision & Removal of Devices except Hip & Femur	231
Arthroscopy, Other Musculoskeletal System & Connective Tissue	232, 233,234
Bilateral or Multiple Major Joint Procedure of Lower Extremity	471

Combined Anterior/Posterior Spinal Fusion; Spinal Fusion; or Back and Neck Procedure	496,497,498,499,500
Knee Procedure with or without Principal Diagnosis of Infection	501,502, 503
Dorsal & lumbar Fusion Procedure for Curvature of Back	303
Vascular Surgery	
Major Cardiovascular Procedures	110,111
Amputation for Circulatory System Disorder except Upper Limb & Toe	113
Upper Limb & Toe Amputation for Circulatory System Disorder	114
Other Circulatory System Procedures	120
Major Abdominal Vascular Procedures	169

Comorbidities

Cancer
Cerebrovascular disease
Congestive Heart Failure
Chronic Pulmonary Disease
Dementia
Diabetes with complications
Diabetes without complications
AIDS/HIV
Metastatic carcinoma
Myocardial Infarction
Mild Liver Disease
Moderate/severe Liver Disease
Paraplegia and Hemiplegia
Peptic Ulcer Disease
Peripheral Vascular Disease
Renal Disease
Connective Tissue Disease - Rheumatic Disease