

Preventable Readmissions Following Common Cancer Surgeries: Lessons Learned from New York State and Targets for Improvement

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ABSTRACT **Background:** Potentially preventable readmissions of surgical oncology patients offer opportunities to improve quality of care. Identifying and subsequently addressing remediable causes of readmissions may improve patient-centered care. **Objectives:** To identify factors associated with potentially preventable readmissions after index cancer operation. **Methods:** The New York State hospital discharge database was used to identify patients undergoing common cancer operations via principal diagnosis and procedure codes between the years 2010 and 2014. The 30-day readmissions were identified and risk factors for potentially preventable readmissions were analyzed using competing risk analysis. **Results:** A total of 53,740 cancer surgeries performed for the following tumor types were analyzed: colorectal (CRC) (42%), kidney (22%), liver (2%), lung (25%), ovary (4%), pancreas (4%), and uterine (1%). The 30-day readmission rate was 11.97%, 47% of which were identified as potentially preventable. The most common cause of potentially preventable readmissions was sepsis (48%). Pancreatic cancer had the highest overall readmission rate (22%) and CRC had the highest percentage of potentially preventable readmissions (51%, hazard ratio [HR] 1.42, 95% confidence interval [95%CI] 1.28–1.61). Risk factors associated with preventable readmissions included discharge disposition to a skilled nursing facility (HR 2.22, 95%CI 1.99–2.48) and the need for home healthcare (HR 1.61, 95% CI 1.48–1.75). **Conclusions:** Almost half of the 30-day readmissions were potentially preventable and attributed to high rates of sepsis, surgical site infections, dehydration, and electrolyte disorders. These results can be further validated for identifying broad targets for improvement.

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KEY WORDS: cancer surgery, New York, preventable hospital admissions, readmission reduction

Frequent readmissions, overcrowded departments and prolonged lengths of stay are highly prevalent and important issues facing hospitals, not only in Israel but also globally [1]. In this setting, readmissions are a significant contributor to health care costs and work load. In the United States, 30-day readmission rates are currently used as a measure of health care quality and affect hospital reimbursement. Identifying potentially preventable readmissions is important for ultimately improving patient outcomes and optimizing high value medical care to reduce costs. Readmissions are viewed as potentially preventable if an improvement in the health care delivery process could have eliminated the need for readmission [2,3]. These can be achieved through enhanced quality of care in initial hospitalization, appropriate timing and planning for discharge, appropriate discharge follow-up, and coordination of inpatient and outpatient health care [2,4]. Furthermore, some contend that a significant proportion of readmissions might be preventable if supportive palliative care were adequately utilized [5].

We identified modifiable risk factors associated with potentially preventable readmissions after cancer surgery. Rather than utilizing single institutional data as many comparable studies have to date [3,4,6], we used a statewide population sample to identify areas with the potential for improvement in outcomes and possible cost saving.

PATIENTS AND METHODS

DATA SOURCES AND COHORT SELECTION

Data were derived from the Statewide Planning and Research Cooperative System (SPARCS), New York State's hospital discharge data. These records were linked with New York (NY) State Vital Statistics death records. The original cohort was defined via International classification of diseases, 9th edition, clinical modification (ICD9-CM), principal diagnosis for most common cancers including: colon, rectal, liver, pancreas, lung,

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uterus, ovary, and kidney with procedure codes for respective cancer operations [Supplementary Table 1]. We included patients who underwent surgery between 2010 and 2014, and incorporated information from this cohort from 2009 to capture existing co-morbidities prior to surgery and during index hospitalization. Co-morbidities were classified with the Elixhauser Comorbidity Index [7,8]. A consort diagram detailing the study cohort is reported in Figure 1.

We excluded cancer patients who were younger than 18 years, diagnosed with metastatic cancer, resided outside of New York State, died during index hospitalization, or had multiple cancers treated in a single index hospitalization. Colon and rectal cancer surgeries were combined into a single colorectal cancer (CRC) category.

The study was approved by the data protection review board of the NY State Department of Health as well as the Program for Protection of Human Subjects at the Icahn School of Medicine at Mount Sinai. The approval included a waiver of informed consent. Cancer Center Grant #P30CA196521.

READMISSIONS

The index admission was defined as the one comprising the cancer surgery. Readmission was defined as any return to an acute inpatient hospital within 30-days of discharge. Any hospitalizations to psychiatric or rehabilitation facilities were not counted as readmissions. Any admission to a different hospital that occurred within 24 hours after discharge was considered a transfer, and both hospitalizations were analyzed as a single admission attributed to the facility where the surgery was performed. Subacute

rehabilitation and skilled nursing facilities (SNFs) were grouped into a single category due to a similar number of services.

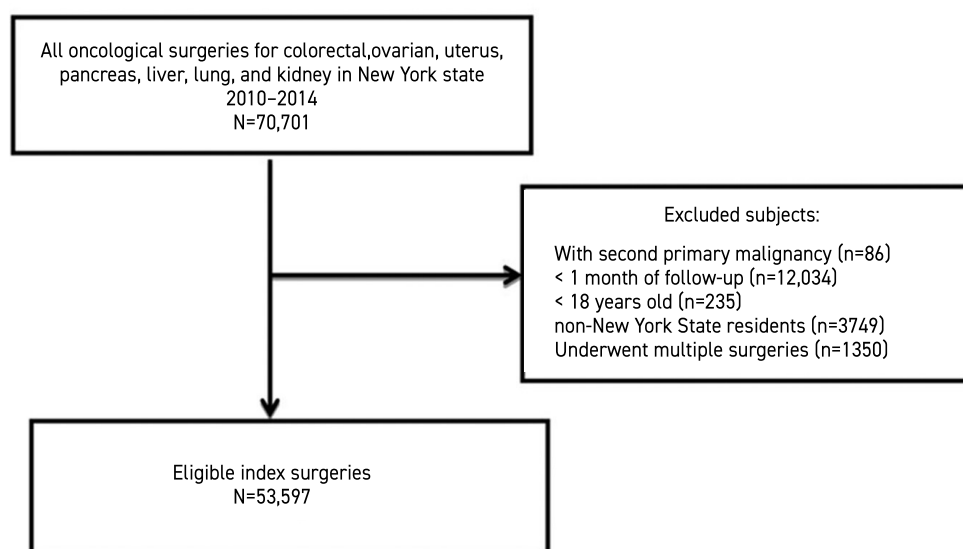
IDENTIFYING POTENTIALLY PREVENTABLE READMISSIONS

Following a thorough literature review [2,4,5,9-15], a working group of surgical oncology surgeons, internal medicine physicians, and health policy specialists defined terms and created a list of potentially preventable readmissions reasons following major cancer operations. This classification scheme is based on previously validated algorithms from the literature and includes surgical as well as nonsurgical reasons for readmission [Supplementary Table 2]. The causes of potentially preventable readmissions were classified as follows: surgical site infection, urinary tract infection (UTI), pneumonia, sepsis, venous thromboembolic event, postoperative cardiovascular event, dehydration/malnutrition/electrolyte disorders, pain, line complications, altered mental status, and other surgery related complications.

STATISTICAL ANALYSIS

Continuous variables were reported as mean with standard deviation. Categorical variables were expressed as proportions. We used a multivariable competing risk model to analyze 30-day readmissions where death within 30 days after discharge was a competing event. To account for clustering of patients within the hospitals, we used a marginal Cox model with a robust sandwich variance estimator. The model included patient characteristics (cancer type diagnosis, patient's age, sex, race/ethnicity, insurance status, co-morbidities, discharge disposition) and hospital characteristics (location (urban/rural), type (public/private),

Figure 1. Study population
Some patients belong to several exclusion criteria



teaching/non-teaching) as covariate. All tests were 2-tailed. An alpha level of 0.05 was considered statistically significant. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

RESULTS

INDEX HOSPITALIZATIONS

A total of 205 New York State hospitals had an index admission for the common cancer surgeries included. Patient characteristics and 30-day readmission rates are outlined in Table 1. A total of 70,701 hospitalizations were identified between 2009 and 2014. A total of 53,740 surgeries were included in our analysis. The largest number of index hospitalizations was among patients 50–64 years of age; 51% of the patients were female; 69% were white, 11% black, 4% Asian, 6% Hispanic, and 11% other race/ethnicity. Almost half of the patients had Medicare insurance (48%), 20% Medicaid, 29% private, 1% uninsured, and 1% other insurance. Index cancer surgery types included CRC (42%), kidney (22%), liver (2%), lung (25%), ovary (4%), pancreas (4%), and uterus (1%). Most patients were discharged home (62%), with 26% discharged home with home healthcare, 10% discharged to a SNF, and approximately 1% to hospice, home hospice, or other locations.

REASON FOR READMISSION AND PREVENTABILITY

Readmission rate after cancer surgeries was 12% (6435/53740) [Table 1]. The malignancy with highest 30-day readmission rate was pancreas (22%), followed by CRC (14%), liver (14%), ovary (12%), lung (11%), uterus (11%), and kidney (8%). Of all readmissions within 30 days 3056 (47%) were identified as potentially preventable. CRC had the highest percentage of potentially preventable 30-day readmissions (51%), followed by kidney, liver, pancreas, lung, ovary, and uterus [Table 1]. The most common cause of potentially preventable readmission was sepsis (48% of readmissions), followed by surgical site infection (28%), dehydration/malnutrition/electrolyte disorders (11%), pneumonia (10%), venous thromboembolic event (9%), other surgical complications (7%), urinary tract infection (6%), pain (3%), post-operative cardiovascular event (2%), and line complications (1%) [Table 2].

Multivariable analysis of risk factors associated with potentially preventable 30-day readmissions [Table 3] showed that patients discharged to SNF/rehabilitation and home healthcare were at higher risk of readmissions: hazard ratio (HR) 2.22, 95% confidence interval (95%CI) 1.99–2.48; and HR 1.61, 95%CI 1.48–1.75, respectively, $P < 0.001$). The malignancy with highest risk for 30-day potentially preventable readmissions is pancreatic cancer (HR 1.82, 95%CI 1.49–2.22) followed by CRC (HR 1.43, 95%CI 1.28–1.61), and liver cancer (HR 1.32, 95%CI 1.01–1.73). Drug abuse is the co-morbidity with the highest

statistically significant risk for 30-day potentially preventable readmissions (HR 1.71, 95%CI 1.20–2.43), followed by coagulopathy (HR 1.45, 95%CI 1.21–1.74), fluid and electrolytes disorders (HR 1.29), diabetes with chronic complications (HR 1.25, 95%CI 1.04–1.50), renal failure (HR 1.28), other neurological disorders (HR 1.25, 95%CI 1.05–1.49), peripheral vascular disease (HR 1.23), and congestive heart failure (HR 1.19). Female sex exerted a protective effect on potentially preventable readmissions (HR 0.82, 95%CI 0.75–0.89).

DISCUSSION

Our results demonstrate a 30-day readmission rate of 12% with almost half of the readmissions identified as potentially preventable. Multiple factors were associated with increased rate of readmissions after cancer surgery. Co-morbidities raise the likelihood of readmissions. Cancer surgeries performed in the abdominal cavity were associated with higher readmission rates for sepsis and surgical site infection. Readmission rates identified in our study are comparable to the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) 12.8% 30-day readmission rate for its cohort of more than 500 hospitals [16], although higher than the 8.3% overall readmission rate of general surgery patients readmitted to a single hospital within 30 days of discharge [3]. Other studies report 30-day overall surgical readmission rate for cancer of 13% to 43%, depending on cancer site [10,17–21] and malignant-related treatments [15,22]. In the present study, as well as in previously published studies [9,19], race and ethnicity were not associated with an increased risk of readmission.

Identifying and addressing risk factors for potentially preventable readmissions from cancer surgeries is challenging but essential. The surgical oncology community has been focusing efforts to improve care quality and patient outcomes, and to eliminate potentially preventable readmissions. Most efforts directed to identify preventable surgical readmissions have consisted of physician adjudication based on chart reviews, and there is no validated objective method to determine whether a readmission is truly preventable or not. The determination of potentially preventable readmission is subjective and therefore may suffer from assignment bias. New tools to accurately identify potentially preventable 30-day readmissions have been internationally validated for medical inpatients [14]. These challenges also have been addressed for surgical patients in general [2] but to the best of our knowledge, complex surgical oncology patients in particular, have no established specific standard for determining preventability of hospital readmissions. Data in our study show a lower rate of potentially preventable readmissions compared to a nationally based study of complex cancer surgeries [15]. Despite our similar readmission classifications and our use of Goldfield criteria as the basis to define preventability, our definition is somehow narrower addressing surgeries for cancer in particular [2].

Table 1. Patient characteristics and 30-day readmission rates

	All index hospitalizations		Discharged alive after index surgery		30-day readmissions**		Preventable 30-day readmissions***	
	N	%*	N	%	N	% of index hospitalization	N	% of 30-day readmissions
	54,597		53,740		6435	12	3054	47
Age, years								
18–49	5606	10	5586	10	559	10	280	5
50–64	17,426	32	17,322	32	1754	10	807	46
65–74	15,715	29	15,493	29	1816	12	834	46
75–84	12,219	22	11,906	22	1716	14	823	48
≥ 85	3631	7	3433	7	590	17	310	53
Sex								
Female	27,713	51	27,350	51	3075	11	1440	47
Male	26,884	49	26,390	49	3360	13	1614	48
Race/ethnicity								
White	37,811	69	37,190	69	4382	12	2100	48
Black	5891	11	5796	11	791	14	357	45
Asian	1968	4	1948	4	191	10	99	52
Hispanic	3045	6	2997	6	431	14	185	43
Other	5882	11	5809	11	640	11	313	49
Insurance								
Medicare	26,451	48	25,869	48	3400	13	1635	48
Medicaid	10,769	20	10,574	20	1432	14	653	46
Private	16,009	29	15,945	29	1461	9	701	48
Uninsured	775	1	770	1	76	10	41	54
Other	593	1	582	1	66	11	24	39
Disposition								
Home	34,107	62	34,107	62	3003	9	1384	46
HHC	13,943	26	13,943	26	2147	15	987	46
SNF	5208	10	5208	10	1203	23	649	54
Hospice	64	0	64	0	4	6	3	75
Home hospice	38	0	38	0	3	8	2	67
Other	380	1	380	1	75	20	19	36
Died	857	2						
Cancer type								
Colorectal	23,029	42	22,545	42	3104	14	1586	51
Kidney	12,047	22	11,981	22	999	8	499	50
Liver	1257	2	1196	2	165	14	79	48
Lung	13,485	25	13,303	25	1410	11	584	41
Ovary	2250	4	2237	4	273	12	99	36
Pancreas	2011	4	1961	4	426	22	186	44
Uterus	518	1	517	1	58	11	21	36

HHC = home healthcare, SNF = skilled nursing facility

*Denominator is the number of index hospitalizations (n=54597)

**Denominator for 30-day readmission is the number of discharged alive after index surgery for each age group, sex, race, insurance

#Denominator is the number of discharge alive (n=53740)

***Denominator for preventable 30-day readmissions is the number of 30-day readmissions for each age group, sex, race

Table 2. Preventable readmission rates by cancer type

	All readmissions		Colorectal		Kidney		Liver		Lung		Ovary		Pancreas		Uterus	
	N	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
All causes	3054		1588		499		78		584		99		185		21	
SSI	845	28	529	33	76	15	36	46	62	11	49	49	82	44	11	52
UTI	170	6	96	6	42	8	3	4	18	3	3	3	8	4	0	0
Pneumonia	302	10	73	5	40	8	2	3	170	29	5	5	10	5	2	10
Sepsis	1454	48	853	54	180	36	47	60	188	32	57	58	115	62	14	67
VTE	261	9	112	7	44	9	6	8	80	14	7	7	9	5	3	14
Postop CV	53	2	23	1	17	3	2	3	11	2	0	0	0	0	0	0
Dehydration / Malnutrition / Electrolyte disorders	338	11	210	13	59	12	7	9	36	6	10	10	15	8	1	5
Pain	106	3	50	3	22	4	2	3	18	3	4	4	10	5	0	0
Line complications	24	1	8	1	2	0	1	1	8	1	0	0	5	3	0	0
Altered mental status	53	2	24	2	13	3	3	4	11	2	1	1	1	1	0	0
Other surgery related complications	227	7	108	7	71	14	3	4	29	5	5	5	10	5	1	

Percents may exceed 100% if patients were hospitalized with >1 potentially preventable diagnoses.

CRC = colorectal cancer, Postop CV = postoperative cardiovascular, SSI = surgical site infection, UTI = urinary tract infection, VTE = venous thromboembolic events

Perhaps the most salient matter in reducing readmissions is determining how much is truly preventable. For instance, the extent to which sepsis is preventable, is unknown. Though, it might be a more comprehensive to state that readmission due to sepsis is in part preventable. The surgical quality NSQIP review of unplanned readmissions found, similar to our study, that most readmissions were related to the procedures but also to the post-discharge site [23]. A significant reduction in 30-day all-cause hospital readmissions after sleeve gastrectomy was accomplished through the first-ever joint national quality improvement collaboration between the American College of Surgeons and the American Society for Metabolic and Bariatric Surgery via a quality improvement program, known as the DROP program (Decreasing Readmissions through Opportunities Provided) [24]. With this program, efforts to reduce potentially preventable hospital readmissions among bariatric surgery patients found that nausea, dehydration and side effects from medications were common reasons for readmission. DROP took a multi-pronged approach to tackle readmissions: they had surgeons perform intra-operative leak checks and mobilize patients quickly; encouraged patients to perform incentive spirometry; worked with nurses, dieticians, psychologists and pharmacists who provided education on diet, hydration, activity, warning signs, stress and anxiety management; and they provided a discharge checklist and

card with provider names and contact information. They reduced readmissions from 8% to 2.5% [24]. Although the surgery type was not oncologic in nature, the use of a multi-disciplinary, multi-pronged approach to reduce readmissions can provide a guide for oncologic surgery. Most oncologic surgeries are elective and not emergent. The elective nature of surgery provides an opportunity in this unique population to intervene perioperatively to decrease the risk of readmission postoperatively. The high proportion of sepsis and surgical infections as a cause for readmission suggests the need for hospital surgical quality personnel to create multi-disciplinary teams to identify and address the pre-, intra- and post-operative care lapses that contribute to these high rates.

Discharge disposition impacts risk of readmission. We found, as others have [25,15], higher rates of readmissions among patients discharged to SNF compared to those discharged home. We would expect sicker patients and those requiring skilled nursing to be at greater risk of readmission. However, the disturbing statistic is the nearly doubled rate of readmission for potentially preventable reasons among patients discharged to SNFs as compared to home. Teams from hospital surgical oncology should consider working with SNF personnel to review and train staff on common post-surgical care procedures that might mitigate readmission. Common sense suggests that patients discharged with homecare may not have been as sick

Table 3. Multivariable analysis of risk factors associated with potentially preventable readmissions

Analysis of maximum likelihood estimates					
Parameter		Hazard ratio	95% confidence intervals		P value
Sex	Female	0.819	0.757	0.885	< 0.0001
	Male				
Age, years	50–64	0.844	0.741	0.961	0.0107
	65–74	0.82	0.694	0.969	0.02
	75–84	0.871	0.711	1.066	0.1808
	85+	0.851	0.68	1.066	0.1614
Race/ethnicity	Asian	0.963	0.804	1.155	0.6853
	Black	1.029	0.916	1.156	0.6268
	Hispanic	1.084	0.906	1.298	0.3787
	Other	0.997	0.874	1.137	0.9666
Insurance status	Medicaid	1.059	0.917	1.223	0.435
	Medicare	1.08	0.937	1.244	0.2864
	Other	0.971	0.723	1.303	0.8419
	Uninsured	1.137	0.853	1.514	0.3811
Cancer type	Colorectal	1.432	1.278	1.605	<.0001
	Liver	1.318	1.007	1.726	0.0444
	Lung	0.925	0.809	1.058	0.2572
	Ovary	1.199	0.967	1.488	0.0981
	Pancreas	1.819	1.494	2.216	<.0001
	Uterus	1.094	0.69	1.736	0.7013
Co-morbidities	Congestive heart failure	1.168	1.035	1.317	0.0118
	Valvular disease	0.853	0.743	0.98	0.0244
	Pulmonary circulation disorder	1.179	0.938	1.483	0.1581
	Peripheral vascular disease	1.232	1.055	1.44	0.0086
	Hypertension	1.033	0.952	1.122	0.4317
	Paralysis	0.857	0.604	1.215	0.3867
	Other neurological disorders	1.252	1.05	1.492	0.0123
	Chronic pulmonary disease	1.094	0.994	1.203	0.0652
	Diabetes without chronic complications	1.162	1.061	1.273	0.0012
	Diabetes with chronic complications	1.247	1.035	1.503	0.0202
	Hypothyroidism	1.042	0.906	1.2	0.5634
	Renal failure	1.277	1.131	1.441	<.0001
	Liver disease	0.974	0.745	1.274	0.8482
	Peptic ulcer disease	1.098	0.277	4.349	0.8941
	Rheumatoid arthritis	1.113	0.854	1.451	0.4275
	Coagulopathy	1.451	1.209	1.742	<.0001
	Obesity	1.089	0.964	1.23	0.1697
	Weight loss	1.134	0.99	1.299	0.069
	Fluid and electrolyte disorders	1.286	1.168	1.416	<.0001
	Blood loss anemia	0.89	0.702	1.13	0.34
	Anemia deficiency	0.956	0.871	1.05	0.3494
	Alcohol abuse	0.876	0.682	1.124	0.2963
	Drug abuse	1.706	1.198	2.427	0.003
	Psychoses	1.093	0.867	1.379	0.4507
	Depression	1.085	0.972	1.212	0.1464
Hospital characteristics	Rural	0.926	0.658	1.302	0.6572
	Teaching hospital	1.051	0.94	1.175	0.3864
	PC_M_D	1	0.997	1.003	0.9211
Disposition	Home healthcare	1.606	1.477	1.746	<.0001
	Hospice	0.345	0.083	1.43	0.1425
	Other	1.376	0.863	2.193	0.1796
	SNF	2.221	1.987	2.484	<.0001

SNF = skilled nursing facility, PC_M_D = percent Medicaid

as those discharged to a care facility; however, their high readmission rate suggests that they may not have received adequate post-surgical care support, highlighting another opportunity to train patients and those providing wound care at home.

Data in this study show no statistical difference in 30-day readmission rate regarding nonmodifiable risk factors such as hospital characteristic, including location and teaching versus non-teaching, and insurance status.

LIMITATIONS

First, while we used a previously created list of ICD-9 codes categorized as potentially preventable causes of readmission following cancer surgery, true validation of this list would require successful intervention to truly know if such readmissions are preventable. Second, it is challenging to determine whether a hospital readmission is attributed to the index admission and potentially preventable, or rather an admission attributable to cancer progression or other co-morbid medical conditions. To address this potential limitation, we chose to analyze 30 days following the index procedure, recognizing that we may capture fewer readmissions but will end with data that are more reliable. Lastly, our findings are subject to the same limitations and biases of any retrospective analysis based on administrative data.

CONCLUSIONS

Identifying potentially preventable readmissions empowers healthcare facilities to provide more patient-centered care and, simultaneously, to reduce unnecessary costs while improving patient outcomes. Our data suggest the importance of improving discharges to SNFs and to ensure that receiving facilities are adequately equipped and trained to handle cancer surgery patients. In addition, hospitals need to identify specific causes of sepsis, surgical site infections, dehydration, and electrolyte disorders that result in potentially preventable readmissions. Our sample represents a large retrospective cohort from New York state and includes a variety of health care systems and diversity of patients. Our results may be generalizable to other states and institutions throughout the world and should be further validated to identify specific targets for improvement.

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Supplementary Table 1. Procedure codes

	PICD-9-CM procedure code	Procedure description		PICD-9-CM procedure code	Procedure description
Colorectal	17.31	Laparoscopic multiple segmental resection of large intestine	Lung	32.20	Thoracoscopic excision of lesion or tissue of lung
	17.32	Laparoscopic cecectomy		32.30	Thoracoscopic segmental resection of lung
	17.33	Lap right hemicolectomy		32.39	Other and unspecified segmental resection of lung
	17.34	Lap res transvers colon		32.4	Lobectomy of lung
	17.35	Lap left hemicolectomy		32.5	Pneumonectomy
	17.36	Lap sigmoidectomy	Uterine and ovary	65.31	Laparoscopic unilateral oophorectomy
	17.39	Other laparoscopic partial excision of large intestine		65.39	Other unilateral oophorectomy
	45.74	Open and other resection of transverse colon		65.64	Laparoscopic removal of remaining ovary and tube
	45.49	Other destruction of lesion of large intestine		68.6	Radical abdominal hysterectomy
	45.71	Open and other multiple segmental resection of large intestine		68.31	Laparoscopic supracervical hysterectomy [LSH]
	45.73	Open and other right hemicolectomy		68.39	Other and unspecified subtotal abdominal hysterectomy
	45.75	Open and other left hemicolectomy		68.4	Total abdominal hysterectomy
	45.76	Open and other sigmoidectomy		68.61	Laparoscopic radical abdominal hysterectomy
	45.79	Other and unspecified partial excision of large intestine		68.69	Other and unspecified radical abdominal hysterectomy
	45.8	Total intra-abdominal colectomy		68.5	Vaginal hysterectomy
	48.62	Anterior resection of rectum with synchronous colostomy		68.7	Radical vaginal hysterectomy
	48.63	Other anterior resection of rectum		68.8	Pelvic evisceration
	48.5	Abdominoperineal resection of rectum		54.4	Excision or destruction of peritoneal tissue
Liver	50.4	Total hepatectomy		65.4	Unilateral salpingo-oophorectomy
	50.22	Partial hepatectomy		65.51	Other removal of both ovaries at same operative episode
	50.3	Lobectomy of liver		65.53	Laparoscopic removal of both ovaries at same operative episode
Pancreas	52.5	Partial pancreatectomy		65.54	Laparoscopic removal of remaining ovary
	52.6	Total pancreatectomy	Kidney	55.4	Partial nephrectomy
	52.7	Radical pancreaticoduodenectomy		55.5	Complete nephrectomy

Supplementary Table 2. ICD-9 diagnosis codes

Readmission reason	ICD-9-CM	Definition	Readmission reason	ICD-9-CM	Definition	Readmission reason	ICD-9-CM	Definition
Surgical site infections	998.5	Postoperative infection not elsewhere classified	Sepsis	038**	Streptococcal septicemia	Line complications	996.59	Mechanical complication due to other implant and internal device, not elsewhere classified
	998.51	Infected postoperative seroma		785.52	Septic shock		996.69	Infection and inflammatory reaction due to other internal prosthetic device, implant, and graft
	998.59	Other postoperative infection		995.91	Sepsis		996.79	Other complications due to other internal prosthetic device, implant, and graft
	569.81	Unspecified local infection of skin and subcutaneous tissue		995.92	Severe sepsis		V58.82	Fitting and adjustment of nonvascular catheter, NEC
	999.3	Other infection due to medical care not elsewhere classified		998.0	Postoperative shock not elsewhere classified		292.0	Drug withdrawal
	112.2	Candidiasis of other urogenital sites		998.59	Other postoperative infection		292.81	Drug-induced delirium
	590.1*	Acute pyelonephritis		999.31	Other and unspecified infection due to central venous catheter		293.0	Delirium due to conditions classified elsewhere
	590.3	Pyeloureteritis cystica		998.02	Postoperative shock, septic	Altered mental status	311.03, 296.33, 296.20, 296.21, 296.23	Depressive disorder, not elsewhere classified
	590.8*	Other pyelonephritis or pyonephrosis not specified as acute or chronic		008.45	Intestinal infection due to Clostridium difficile		332.0	Paralysis agitans
	595	Acute cystitis		A04.7	Enterocolitis due to Clostridium difficile		780.01	Coma
Urinary tract infections	595.3	Trigonitis	Venous thromboembolic events	415.1*	Pulmonary embolism and infarction		780.02	Transient alteration of awareness, Syncope and collapse
	599	Urinary tract infection, site not specified		451.1*	Phlebitis and thrombophlebitis		780.09	Other alteration of consciousness
	996.64	Urinary and inflammatory reaction due to indwelling urinary catheter		451.12	Phlebitis and thrombophlebitis of lower extremities, unspecified		564.3	Vomiting following gastrointestinal surgery
	039.1	Pulmonary actinomycotic infection		451.81	Phlebitis and thrombophlebitis of iliac vein		569.60	Colostomy and enterostomy complication, unspecified
	112.4	Candidiasis of lung		451.9	Phlebitis and thrombophlebitis of unspecified site		569.62	Mechanical complication of colostomy and enterostomy
	136.3	Pneumocystosis		453.4*	Other venous embolism and thrombosis		569.69	Other colostomy and enterostomy complication
	466.19	Acute bronchiolitis due to other infectious organisms		453.8	Acute venous embolism and thrombosis of other specified veins		998.10	Hemorrhage or hematoma complicating a procedure not elsewhere classified
	480*	Viral pneumonia	Postoperative cardiovascular	453.9	Other venous embolism and thrombosis of unspecified site		998.11	Hemorrhage complicating a procedure
	481	Pneumococcal pneumonia [Streptococcus pneumoniae pneumonia]		997.02	Iatrogenic cerebrovascular infarction or hemorrhage		998.3	Disruption of operation wound
	482*	Other bacterial pneumonia		410**	Acute myocardial infarction	Surgery-related complications	546.1	Recluse of postoperative disruption of abdominal wall
Pneumonia	483*	Pneumonia due to mycoplasma pneumoniae	Dehydration / Malnutrition / Electrolyte disorders	263.8	Other protein-calorie malnutrition		285.1	Acute post-hemorrhagic anemia
	484.1	Pneumonia in cytomegalic inclusion disease		263.9	Unspecified protein-calorie malnutrition		459.0	Other disorders of circulatory system, hemorrhage, unspecified
	484.6	Pneumonia in aspergillosis		273.8	Other disorders of plasma protein metabolism		568.81	Hemoperitoneum
	484.7	Pneumonia in other systemic mycoses		275.42	Hypercalcemia			
	485	Bronchopneumonia, organism unspecified		276.0	Hyposmolality and/or hyponatremia			
	486	Pneumonia, organism unspecified		276.1	Hyposmolality and/or hypernatremia			
	487.0	Influenza with pneumonia		276.2	Acidosis			
	507*	Pneumonitis due to inhalation of food or vomitus		276.5	Volume depletion disorder			
	513.0	Abscess of lung		276.8	Hypopotassemia			
	516.8	Other specified alveolar and parietoalveolar pneumonopathies	Pain	458.0	Orthostatic hypotension			
	997.31	Ventilator associated pneumonia		458.8	Other iatrogenic hypotension			
	997.39	Other respiratory complications		458.9	Hypotension, unspecified			
	514	Pulmonary congestion and hypostasis		707.0	Pressure ulcer			
	997.3	Respiratory complications		783.3	Feeding difficulties and mismanagement			
	484.3	Pneumonia in whoop cough		783.7	Adult failure to thrive			
	484.5	Pneumonia in anthrax		586	Renal failure, unspecified			
	487.1	Influenza with other respiratory manifestations		584*	Acute kidney failure			
	487.8	Influenza with other manifestations		724.2	Lumbago			
	498.0	Influenza due to identified avian influenza virus		789.00	Abdominal pain, unspecified site			
	488	Influenza due to certain identified influenza viruses		789.01	Abdominal pain, right upper quadrant			
	488.01	Influenza due to identified avian influenza virus with pneumonia		789.02	Abdominal pain, left upper quadrant			
	488.02	Influenza due to identified avian influenza virus with other respiratory manifestations		789.03	Abdominal pain, right lower quadrant			
	488.09	Influenza due to identified avian influenza virus with other manifestations		789.04	Abdominal pain, left lower quadrant			
	488.1	Influenza due to identified 2009 H1n1 influenza virus		789.06	Abdominal pain, epigastric			
	488.11	Influenza due to identified 2009 H1N1 influenza virus with pneumonia		789.07	Abdominal pain, generalized			
	488.12	Influenza due to identified 2009 H1N1 influenza virus with other respiratory manifestations		789.09	Abdominal pain, other specified site			
	488.19	Influenza due to identified 2009 H1N1 influenza virus with other manifestations		338.18	Other acute postoperative pain			
	488.81	Influenza due to identified novel influenza A virus with pneumonia						
	484.8	Pneumonia in other infectious diseases classified elsewhere						
	488.82	Influenza due to identified novel influenza A virus with other respiratory manifestations						
	488.89	Influenza due to identified novel influenza A virus with other manifestations						

*Represents all numbers in the 4th and/or 5th digits