

The validity of hospital administrative data for outcome measurement after hip replacement

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Abstract

Background: Because of the increasing availability of clinical information on the basis of electronically processed data obtained through the hospital discharge records in the HIS, large databases are being set up to develop risk-adjustment models for outcome assessment.

This study is aimed at assessing the validity of hospital discharge data from the Hospital Information System (HIS) of patients with hip arthroplasty.

Methods: 677 records were extracted from the database of the pilot project “Lazio Region Hip Arthroplasty Register (Ripa-L)” and were compared to the corresponding HIS discharge records. The Ripa-L dataset was used as a reference to evaluate the completeness and accuracy of the socio-demographic and clinical HIS data.

Results: Data such as the patients’ age and sex, principal diagnosis, and surgical procedures, showed a very high level of agreement. By contrast, clinical information about comorbidities on admission and in-hospital complications mostly showed unacceptable variances in the datasets. The sensitivity of hospital data reporting was generally very low for almost all conditions, with the highest value being observed for diabetes (58%) and the lowest for endocrine and peripheral venous diseases (4%).

Conclusions: Gaps in clinical information may compromise the ability to carry out high quality appraisals. In particular, the underreporting of comorbidities in hospital administrative data may lead to misestimation of the providers’ skill and quality of care, as a consequence of imperfect risk-adjustment. Stakeholders should highlight the potentialities related to the use of high quality administrative datasets also in clinical evaluations by stimulating health professionals to further improve the quality of the collected data.

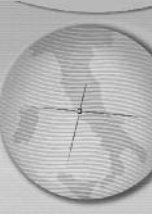
Key words: register, registry, data quality, outcome assessment, discharge records

Introduction

A large amount of data related to outcomes, biomaterials, surgical techniques, complications and socio-economic issues related to total hip arthroplasty (THA) surgery is published yearly and is readily available to physicians, patients and third party payers, reflecting the fast development of surgical technique and implant technology. A Pubmed search performed on August 1, 2008 using only the MeSH term “Arthroplasty, Replacement, Hip” returned 783 records in the last year alone. However, this abundance of potentially available information shows certain limitations: basic research studies have limited evidence in clinical settings; randomized

controlled trials can only address targeted questions; moreover these trials must deal with ethical restrictions and are usually performed in high volume centres, so that they do not reflect standard medical “real life” practice [1]; finally, many clinical studies are weakly designed (e.g. retrospective or uncontrolled series, underpowering or no sample size calculation) and often report short term outcomes in non-standardized fashion or by means of non-validated measures, even though numerous calls for action to address these shortcomings have been made [2,3].

In these circumstances it may be difficult to objectively monitor the clinical results, to build up predictive models where selection and



information biases have been minimized and to finally allow researchers to develop evidence-based treatment guidelines which are universally accepted [4]. In this research area a major role can be played by well-conducted observational studies. In recent years, a number of databases on THA have been initiated in several countries, largely driven by the successful experiences of Scandinavian joint registries [5-13], whose endpoint is the measurement of the revision rate. Hip registers can provide actual and reliable data about the performance of different implants on a large basis giving surgeons all the necessary information they need to select the best implant. Hip registers can also provide accurate information about unacceptable failure rates of implants thus allowing health authorities a prompt removal of problematic implants from the market [10-14]. By contrast, from an outcome measurement perspective, the sole assessment of the revision rate provides limited information. However, requesting extensive clinical data might reduce the compliance since it means an increase in the surgeons' workload.

This has lead researchers to assess the potential use of existing health data systems. Over the last decades, administrative data have been considered to evaluate service use and to develop risk-adjustment models for outcomes. Therefore, it is essential to estimate the validity of using hospital discharge databases as a reliable tool for outcomes assessment in hip replacement surgery [15-27].

The aim of this study was to evaluate the completeness and accuracy of socio-demographic and clinical data which is routinely collected by the Hospital Information System in a sample of hip arthroplasty patients and compare these data with the information collected for the same subset of patients within the pilot project "Lazio Region Hip Arthroplasty Register (Ripa-L)" [28-29] a reliable and more detailed source of data for this procedure.

Methods

Data sources

The pilot project "Lazio Region Hip Arthroplasty Registry (Ripa-L)" was conducted from February 1, 2004 to December 31, 2004 as part of a multi-regional pilot phase of a network of regional arthroplasty registries in Italy. This study was a first attempt which led to the organization of a national project [30]. The national project's is still ongoing and its final goal is to combine regional registries in a national Italian register dataset and thus initiate a multistage benchmark process and

a continuous process of improvement.

Within the Ripa-L project twenty-two orthopaedic centres, performing about 50% of all hip replacement operations in the Lazio region, participated in the systematic and prospective collection of data. A standardized case report form (CRF) was used to gather information on patient demographics, receive clinical information about the diagnosis that leads to hip replacement, as well as the presence of twelve comorbid conditions on admission (hypertension, diabetes mellitus, cardiovascular diseases, cerebrovascular diseases, chronic renal diseases, malignancy, respiratory diseases, endocrine diseases, hematologic diseases, nervous system diseases, peripheral venous diseases and gastrointestinal diseases). Other details on the operation such as the type of intervention (partial or total hip replacement, hip revision), side of hip replacement, characteristics of the prosthesis, and postoperative complications were also collected.

In each centre, trained chart reviewers filled out the CRF form at the time of the patient's discharge from hospital on the basis of the medical chart.

The Lazio region Hospital Information System (HIS) routinely collects data about hospitalized patients. The database provides information on patient demographics (including birthplace, age, sex, marital status and education), in-hospital procedures and treatments, principal diagnosis, and up to five other conditions (secondary diagnoses) that may have been present during the patient's stay in hospital. Diagnoses (principal and secondary) and procedures are coded using ICD-9-CM version 1997.

Study population

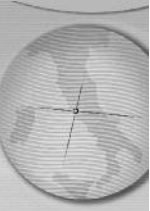
The Ripa-L database, containing 677 records of patients hospitalized for hip replacement and revision during 2004, was linked with the HIS database. The linkage procedure was based on the following keys: name, surname, place and date of birth, and date of hospital admission.

Of the initial Ripa-L records, 662 (98%) were successfully linked with the HIS database and then considered for analysis.

Statistical methods

Principal diagnoses from the HIS database were grouped into three categories: "arthrosis/arthritis" (ICD-9-CM codes 714 and 715.15); "fracture" (codes 716.1, 820, 821, 733.14, and 733.82); and "other" (remaining diagnoses).

The type of intervention was defined using ICD-9-CM codes for procedures and classified as "total hip replacement" (81.51), "partial hip



replacement" (81.52), "revision of hip arthroplasty" (81.53) and "other".

In order to reproduce the twelve corresponding categories in the Ripa-L CFR, an initial list of comorbidities was selected from the HIS records using the secondary diagnosis fields and then grouped under the heading "comorbid conditions" (Appendix 1). The presence of each specified comorbid condition was then ascertained for all hospital admissions within the 5 years preceding the index admission.

The occurrence of in-hospital complications after primary hip replacement was also analyzed.

The reliability of socio-demographic data (sex, age, marital status and educational level) and clinical information (type of intervention and principal diagnoses) derived from the Ripa-L register as well as HIS records were assessed by using the agreement percentage for categorical variables, and Pearson's correlation coefficient for continuous variables.

To evaluate the validity of the HIS data source in recording comorbid conditions and post-operative complications, sensitivity (Se) and specificity (Sp) were calculated by assuming the Ripa-L source as a reference. In general, sensitivity is the proportion of true positives correctly identified by a test. In this context, it measured the extent to which the HIS data source correctly records specific conditions that are actually present. Specificity is the proportion of correctly identified true negatives. In this study, it measured the extent to which the HIS data source correctly reports the absence of specific conditions that are actually absent.

Data analyses were conducted using the STATA 8.0 statistical package.

Results

Data sources

Of the 662 subjects included in the study, 637 had a primary hip replacement and 25 had revision arthroplasty. The mean age was 73 years, 66% were females.

Table 1 shows the distribution of patients by sex, marital status and educational level according to the two data sources.

A nearly identical distribution was observed for sex with a very high level of agreement (99.5%). Although the agreement remained quite high (87.7%), a tendency in the HIS database to report 'married' instead of 'widowed' status was observed. There was some difference between Ripa-L and HIS records for educational level while a nearly complete agreement was observed for age at admission ($r = 0.99$).

The frequency of different types of intervention and principal diagnoses among primary hip replacement patients is reported separately for the Ripa-L and the HIS database in Table 2.

A high level of agreement was found between the two sources for both variables. Only 11% of the partial hip replacements were wrongly recorded.

Table 3 examines the prevalence of the twelve comorbidities considered in the Ripa-L case report form. Of the 637 patients undergoing primary hip arthroplasty, 287 (45%) presented hypertension, 135 (21%) cardiovascular and cerebrovascular diseases, and 62 (10%) diabetes. Compared with the register data, the HIS data underestimated the prevalence of almost all comorbidities, with the exception of hematologic and respiratory diseases, and diabetes.

Sensitivity and specificity of HIS data reporting were also calculated as a measure of the validity of administrative sources in documenting the presence of comorbid conditions. Sensitivity varied greatly among diseases but was generally low. The highest value was observed for diabetes (58%) and the lowest for endocrine and peripheral venous diseases (4%). By contrast, specificity was very high for almost all conditions. The lowest value was 87% for hematologic diseases.

The search for comorbidities was also extended to all hospital admissions within the 5 years preceding the index admission in order to maximize the completeness of reporting. The results are summarized in Table 4.

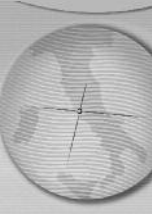
Sensitivity increased for all conditions with the greatest increase observed for chronic renal diseases (+36%) and cardiovascular diseases (+23%). On the contrary, specificity decreased to levels under 90% for hypertension (83%), hematologic diseases (86%), cardiovascular diseases (86%), and respiratory diseases (90%).

Concerning in-hospital complications, 48 post-operative acute diseases were recorded on the register form. HIS database sensitivity in reporting any complications was 27% and specificity 97%.

Discussion

Because of the increasing availability of clinical information on the basis of electronically processed data obtained through the hospital discharge records in the HIS, large databases are being set up and used more and more to develop risk-adjustment models for outcome assessment in public health institutions [23, 26, 31].

The advantages of using these data are numerous. They are readily available, collected in



a standardized way, inexpensive to collect and to use, and computer readable. Moreover, they encompass all of the hospitalized population.

The clinical content of hospital administrative data includes, among others, demographic characteristics, patient principal diagnosis and procedure codes. These data are clearly defined and they are an indispensable piece of information required by clinical departments for patient care and administration. Our study showed a high degree of correspondence between the afore-mentioned kind of data collected through the hospital discharge records and the respective data collected through the register. In our opinion these data might therefore be considered as valid.

However, we did not find a sufficient agreement between discharge records and register documentation for other clinical information such as comorbidities and complications. These data are neither mandatory nor crucial for hospitals to receive reimbursement by the National Health System, since the coding procedures state that secondary diagnoses (comorbidities or complications) should be considered in the discharge abstract only if they imply additional resources and costs [32].

Our study indicates that in many cases comorbidities and risk factors are under-coded in administrative data in comparison to more accurate clinical data sources. Therefore they cannot be regarded as a valid base for outcome measurement.

Gaps in clinical information may compromise the ability to derive high quality appraisals from such data. The underreporting of comorbid conditions is an important concern because it results in patients appearing to be healthier than they are in reality. As a consequence of imperfect risk-adjustment, this may lead to misestimate the providers' skill and quality of care. Finally, the underreporting of in-hospital complications rules out the possibility of their use as a possible outcome measure.

Furthermore, routine monitoring in public health following the standards adopted in *ad hoc* data collections, as is usual with clinical studies, is extremely limited since the size of these datasets would by far exceed the available resources. Thus, the quality of the basic clinical data collected in administrative datasets is decisive to implement a routine outcome assessment programme. Currently, different methods are being applied to improve the quality of these data. One of them is to detect comorbid conditions of patients by analysing all their hospital admissions preceding the index admission, as performed in this study. Another method considers the inclusion of an additional minimum set of clinical variables that are essential to define the severity of patient conditions at admission also in the discharge abstract [33].

It is therefore important that stakeholders highlight the potentialities related to the use of high quality administrative datasets, also in clinical evaluations. This could also be done by informing health professionals and health care workers about the necessity to return high quality hospital discharge record data in order to create high quality databases which provide reliable results to support them in their daily practice.

Acknowledgements

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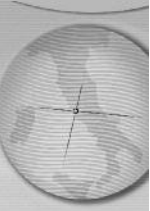


Table 1. Frequency of reporting and agreement between the Ripa-L register and the HIS database for basic demographic information.

Demographic information	Ripa-L		HIS		% agreement
	N	%	N	%	
Sex	662	100.0	662	100.0	99.5
male	227	34.3	224	33.8	
female	435	65.7	438	66.2	
Marital status	643	97.1	662	100.0	87.7
single	57	8.9	48	7.3	
married	377	58.6	433	65.3	
divorced	9	1.4	11	1.7	
widowed	200	31.1	170	25.7	
Educational level	662	100.0	662	100.0	75.7
none	60	9.1	45	6.8	
primary school	289	43.7	324	48.9	
secondary school	154	23.3	168	25.4	
high school	116	17.5	100	15.1	
university degree	43	6.5	25	3.8	
Age (years)	661	99.8	662	100.0	Pearson's correlation 0.999

Table 2. Frequency of reporting and agreement between the Ripa-L register and the HIS database among primary hip replacement patients, by the type of intervention and principal diagnosis.

Clinical information	Ripa-L		HIS		% agreement
	N	%	N	%	
Type of intervention	637	100	637	100.0	96.2
total hip replacement	505	79.3	512	80.4	
partial hip replacement	132	20.7	118	18.5	
other			7	1.1	
Principal diagnosis	637	100.0	637	100.0	89.3
arthrosis/arthritis	389	61.1	425	66.7	
fracture	195	30.6	201	31.6	
other diagnosis	53	8.3	11	1.7	

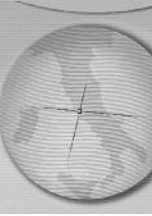


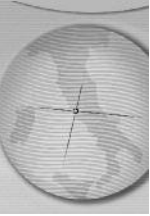
Table 3. Prevalence of comorbid conditions by data source and validity of recording of the HIS database compared with the Ripa-L register, by specific comorbidity.

Comorbid condition	Ripa-L (N=637)		HIS (N=637)		Se	Sp
	N	%	N	%		
Endocrine diseases	48	7.5	2	0.3	4.2	100.0
Peripheral venous diseases	24	3.8	2	0.3	4.2	99.8
Gastrointestinal diseases	29	4.6	7	1.1	6.9	99.2
Cerebrovascular diseases	41	6.4	7	1.1	7.3	99.3
Hematologic diseases	13	2.0	85	13.3	15.4	86.7
Respiratory diseases	42	6.6	46	7.2	19.0	93.6
Chronic renal diseases	13	2.0	4	0.6	23.1	99.8
Malignancy	18	2.8	7	1.1	27.8	99.7
Cardiovascular diseases	94	14.8	79	12.4	33.0	91.3
Nervous System diseases	21	3.3	13	2.0	33.3	99.0
Hypertension	287	45.0	137	21.5	33.8	88.6
Diabetes mellitus	62	9.7	70	11.0	58.1	94.1

Table 4. Changes in the validity of recording of the HIS database compared with the Ripa-L register when considering index and previous admissions' data, by comorbid condition*.

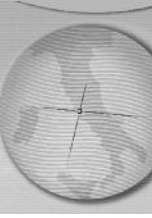
Comorbid condition	Index admission		Index+previous admissions		Δ(Se)	Δ(Sp)
	Se	Sp	Se	Sp		
Endocrine diseases	4.4	100.0	17.4	98.7	+13.0	-1.3
Peripheral venous diseases	4.8	99.8	4.8	98.4	+0.0	-1.4
Cerebrovascular diseases	7.7	99.4	23.1	98.1	+15.4	-1.3
Gastrointestinal diseases	8.0	99.1	20.0	94.0	+12.0	-5.1
Chronic renal diseases	18.2	99.8	54.5	97.9	+36.3	-1.9
Hematologic diseases	20.0	85.9	30.0	85.5	+10.0	-0.4
Respiratory diseases	20.5	93.1	30.8	89.6	+10.3	-3.5
Malignancy	33.3	99.6	46.7	98.6	+13.4	-1.0
Nervous System diseases	33.3	98.9	38.1	96.8	+4.8	-2.1
Cardiovascular diseases	34.9	90.8	58.1	85.9	+23.2	-4.9
Hypertension	35.1	88.2	49.2	82.5	+14.1	-5.7
Diabetes mellitus	60.3	93.8	69.0	93.1	+8.7	-0.7

(*)The analysis was restricted to patients resident in the Lazio Region (N=537).



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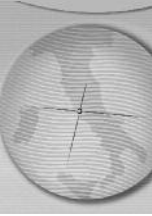


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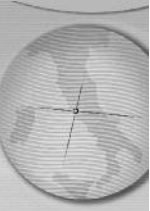
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Appendix 1. List of comorbid conditions (and excluded diagnoses) with corresponding ICD-9-CM codes.

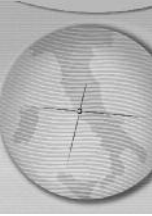
Comorbid condition	ICD-9-CM Category	ICD-9-CM codes	Excluded diagnoses	
Hypertension	Hypertensive disease	401	Essential hypertension	
		402	Hypertensive heart disease	
		403	Hypertensive kidney disease	
		404	Hypertensive heart and kidney disease	
		405	Secondary hypertension	
Diabetes mellitus Cardiovascular diseases	Diabetes mellitus	250	Diabetes mellitus	
	Chronic rheumatic heart disease	393	Chronic rheumatic pericarditis	
		394-	Diseases of mitral valve and/or aortic valve	
		396	Diseases of other endocardial structures	
		397	Other rheumatic heart disease	
		398	Other acute and subacute forms of ischemic heart disease	
	Ischemic Heart disease	411	Old myocardial infarction	
		412	Angina pectoris	
		413	Other forms of chronic ischemic heart disease	
		414	Chronic pulmonary heart disease	
	Diseases of pulmonary circulation	416	Other diseases of pulmonary circulation	
		417	Other diseases of pulmonary circulation	
	Other forms of heart disease	423	Other diseases of pericardium	423.0 hemopericardium
			Other diseases of endocardium	
		425	Cardiomyopathy	
426		Conduction disorders		
427		Cardiac dysrhythmias	427.0 Paroxysmal supraventricular tachycardia	
			427.1 Paroxysmal ventricular tachycardia	
			427.5 Cardiac arrest	
428		Heart failure		
429		Ill-defined descriptions and complications of heart disease	429.5	Rupture of chordae tendinae
			429.6	Rupture of papillary muscle
Congenital anomalies	745	Bulbus cordis anomalies and anomalies of cardiac septal closure		
		Other congenital anomalies of heart		
		747.1	Coarctation of aorta	
		747.2	Other anomalies of aorta	
		747.3	Anomalies of pulmonary artery	
		747.4	Anomalies of great veins	
Cerebrovascular diseases	Cerebrovascular disease	433	Occlusions and stenosis of precerebral arteries	



Comorbid condition	ICD-9-CM Category	ICD-9-CM codes	Excluded diagnoses		
Cerebrovascular diseases (continued)	Cerebrovascular disease(continued)	437	Other and ill-defined cerebrovascular disease		
		438	Late effects of cerebrovascular disease		
Chronic renal diseases	Diseases of the genitourinary system	581	Nephrotic syndrome		
		582	Chronic glomerulonephritis		
		585	Chronic kidney disease (CKD)		
		587	Renal sclerosis unspecified		
		588	Disorders resulted from impaired renal function		
		589	Small kidney of unknown cause		
		590.0	Chronic pyelonephritis		
		591	Hydronephrosis		
		592	Calculus of kidney		
		593	Other disorders of kidney and ureter		
		V45.1	Renal dialysis status		
		V42.0	Organ or tissue replaced by transplant. Kidney		
		Malignancy	Neoplasms	140-149	Malignant neoplasm of lip, oral cavity, and pharynx
				150-159	Malignant neoplasm of digestive organs and peritoneum
				160-165	Malignant neoplasm of respiratory and intrathoracic organs
				170-176	Malignant neoplasm of bone, connective tissue, skin, and breast
				179-189	Malignant neoplasm of genitourinary organs
190-199	Malignant neoplasm of other and unspecified sites				
200-208	Malignant neoplasm of lymphatic and hematopoietic tissue				
Respiratory diseases	Diseases of the respiratory system			470	Deviated nasal septum
				471	Nasal polyps
				472	Chronic pharyngitis and nasopharyngitis
		473	Chronic sinusitis		
		474	Chronic disease of tonsils and adenoids		
		475	Peritonsillar abscess		
		476	Chronic laryngitis and laryngotracheitis		
		477	Allergic rhinitis		
		478	Other diseases of upper respiratory tract		
		490	Bronchitis not specified as acute or chronic		
		491	Chronic bronchitis		
		492	Emphysema		
		493	Asthma		
494	Bronchiectasis				

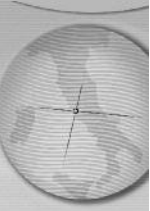


Comorbid condition	ICD-9-CM Category	ICD-9-CM codes	Excluded diagnoses	
Respiratory diseases (continued)	Diseases of the respiratory system (continued)	495	Extrinsic allergic alveolitis	
		496	Chronic airway obstruction, not elsewhere classified	
		500	Coal workers' pneumoconiosis	
		501	Asbestosis	
		502	Pneumoconiosis due to other silica or silicates	
		503	Pneumoconiosis due to other inorganic dust	
		504	Pneumopathy due to inhalation of other dust	
		505	Pneumoconiosis, unspecified	
		506	Respiratory conditions due to chemical fumes and vapors	
		507	Pneumonitis due to solids and liquids	
		508	Respiratory conditions due to other and unspecified external agents	
		515	Postinflammatory pulmonary fibrosis	
		516	Other alveolar and parietoalveolar pneumonopathy	
		518.1	Interstitial emphysema	
		518.2	Compensatory emphysema	
		518.3	Pulmonary eosinophilia	
Endocrine diseases	Endocrine, nutritional and metabolic diseases, and immunity disorders	240	Simple and unspecified goiter	
		241	Nontoxic nodular goiter	
		242	Thyrotoxicosis with or without goiter	
		243	Congenital hypothyroidism	
		244	Acquired hypothyroidism	
		245	Thyroiditis	245.0 Acute thyroiditis 245.1 subacute thyroiditis
		246	Other disorders of thyroid	
		252	Disorders of parathyroid gland	
		253	Disorders of the pituitary gland and hypothalamic control	253.7 Iatrogenic pituitary disorders 253.8 Other disorders of the pituitary and other syndromes of diencephalohypophys- eal origin
		256	Ovarian dysfunction	
		257	Testicular dysfunction	
258	Polyglandular dysfunction and related disorders			
259	Other endocrine disorders			
Hematologic diseases	Diseases of the blood and blood-forming organs	280	Iron deficiency anemias	
		281	Other deficiency anemia	
		282	Hereditary hemolytic anemia	

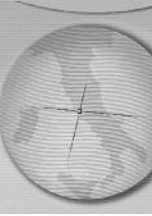


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Comorbid condition	ICD-9-CM Category	ICD-9-CM codes	Excluded diagnoses		
Hematologic diseases (continued)	Diseases of the blood and blood-forming organs (continued)	284 Aplastic anemia			
		285 Other and unspecified anemias	285.1 Acute posthemorrhagic anemia		
		286 Coagulation defects			
		288 Diseases of white blood cells			
		289 Other diseases of blood and blood-forming organs			
		Nervous system diseases	Diseases of the nervous system and sense organs	330 Cerebral degeneration usually manifest in childhood	
				331 Other cerebral degeneration	
				332 Parkinson's disease	
				333 Other extrapyramidal disease and abnormal movement disorders	
				334 Spinocerebellar disease	
335 Anterior horn cell disease					
336 Other diseases of spinal cord					
337 Disorders of the autonomic nervous system					
340 Multiple sclerosis					
341 Other demyelinating diseases of central nervous system					
342 Hemiplegia and hemiparesis					
343 Infantile cerebral palsy					
344 Other paralytic syndromes					
345 Epilepsy					
346 Migraine					
347 Cataplexy and narcolepsy					
348 Other conditions of brain					
349 Other and unspecified disorders of the nervous system	349.1 Nervous system complications from surgically implanted device				
	350 Trigeminal nerve disorders				
	351 Facial nerve disorders				
	352 Disorders of other cranial nerves				
	353 Nerve root and plexus disorders				
	354 Mononeuritis of upper limb and mononeuritis multiple x				
	355 Mononeuritis of lower limb				
	356 Hered and idiopathic peripheral neuropathy				
	357 Inflammatory and toxic neuropathy	357.0 Acute infective polyneuritis 357.6 Polyneuropathy due to drugs			
	358 Myoneural disorders				
	359 Muscular dystrophies and other myopathies				
Peripheral venous diseases	Diseases of the circulatory system	440.2 Atherosclerosis of native arteries of the extremities	440.23 Atherosclerosis of the extremities with ulceration 440.24 Atherosclerosis of the extremities with gangrene		



Comorbid condition	ICD-9-CM Category	ICD-9-CM codes	Excluded diagnoses		
Peripheral venous diseases (continued)	Diseases of the circulatory system (continued)	443.9	Peripheral vascular disease, unspecified		
		454	Varicose veins of lower extremities		
		459.81	Venous (peripheral) insufficiency, unspecified		
Gastrointestinal diseases	Diseases of the digestive system	530	Diseases of esophagus		
		531	Gastric ulcer		
		532	Duodenal ulcer		
		533	Peptic ulcer, site unspecified		
		534	Gastrojejunal ulcer		
		535	Gastritis and duodenitis		
		536	Disorders of function of stomach		
		537	Other disorders of stomach and duodenum		
		550.9	Inguinal hernia, without mention of obstruction or gangrene		
		553	Other hernia of abdominal cavity without mention of obstruction or gangrene		
		555	Regional enteritis		
		556	Ulcerative colitis		
		557	Vascular insufficiency of intestine	557.0 Acute vascular insufficiency of intestine	
		558	Other and unspecified noninfectious gastroenteritis and colitis		
		562	Diverticula of intestine	562.02	Diverticulosis of small intestine with hemorrhage
				562.03	Diverticulitis of small intestine with hemorrhage
				562.12	Diverticulosis of colon with hemorrhage
				562.13	Diverticulitis of colon with hemorrhage
		564	Functional digestive disorders not elsewhere classified	564.3	Vomiting following gastrointestinal surgery
				564.4	Other postoperative functional disorders
565	Anal fissure & fistula				
568	Other disorders of peritoneum				
569	Other disorders of intestine	569.3	Hemorrhage of rectum and anus		
		569.5	Abscess of intestine		
571	Chronic liver disease and cirrhosis				
573	Other disorders of liver				
574	Cholelithiasis				
575	Other disorders of gallbladder	575.0	Acute cholecystitis		
		575.2	Obstruction of gallbladder		



Comorbid condition	ICD-9-CM Category	ICD-9-CM codes	Excluded diagnoses
Gastrointestinal diseases (continued)	Diseases of the digestive system (continued)	576 Other disorders of biliary tract	575.3 Hydrops of gallbladder
			575.4 Perforation of gallbladder
			575.5 Fistula of gallbladder
			576.1 Cholangitis
			576.2 Obstruction of bile duct
			576.3 Perforation of bile duct
			576.4 Fistula of bile duct
			577.0 Acute pancreatitis
			577 Diseases of pancreas
			579 Intestinal malabsorption