Supplemental digital content 4. International Classification of Diseases (ICD) versions 9-CM and 10-CA code definitions for comorbidities[i].

Comorbidity and Subcategories	**Codes included in the definition[ii]**
Ischemic heart disease	410.xx, 411.xx, 412.xx, 413.xx, 414.xx, I20.xx, I21.xx, I22.xx, I24.xx, I25.xx
Cerebrovascular accident	
Intracranial hemorrhage	430, 431, 432.x, I60.x, I61.x, I62.x
Cerebral Infarction	433.x1, 434.x1, 997.02, I63.x, I64
Transient or chronic cerebral ischemia	435.x, 437.1, V12.54, 997.01, I67.8
Late effects of cerebrovascular disease	438.x, I69.x
Renal disease	
Hypertensive renal disease	403.x, 404.x, I12
Diabetes mellitus with renal disease	249.4, 250.4, E10.2x, E11.2x, E13.2x, E14.2x
Nephritis, nephrotic syndrome, nephrosis	580.x, 581.x, 582.x, 583.x, 585.x, 586.x, 587.x, N00.x, N01.x, N03.x, N04.x, N05.x, N07.x, N08.x, N14.x, N16.x, N18.x, N19
Diabetes mellitus	249.xx, 250.xx, E10.xx, E11.xx, E13.xx, E14.xx
Chronic obstructive pulmonary disease	
Chronic bronchitis	491.xx, J41.x, J42
Emphysema	492.x, J43.x
Asthma, other chronic airway obstruction	493.xx, 496, J44.x, J45.xx
Congestive heart failure	
Heart failure	428.xx, I50.x
With hypertensive heart disease	402.01, 402.11, 402.91
With hypertensive heart and kidney disease	404.01, 404.11, 404.91, 404.03, 404.13, 404.93

[i]The patient was considered to have a comorbidity at the time of surgery if the surgery occurred after the date of first diagnosis of the comorbidity.

[ii]Physician service claims are recorded in ICD-9-CM with 3 digits. Hospital discharge abstracts were recorded in ICD9-CM until March 31, 2004 and subsequently in ICD10-CA. All ICD digits and up to 25 diagnoses are coded in hospital discharge abstracts. .x and .xx indicate root and all subcategories are included in the definition. Codes are based on the following references [1-8] :

1. Lix L, Yogendran M, Burchill C, Metge C, McKeen N, Moore D, and Bond R: Defining and Validating Chronic Diseases: An Administrative Data Approach. 2006
2. Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, Saunders LD, Beck CA, Feasby TE, Ghali WA: Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care 2005; 43: 1130-9

3. Kern EF, Maney M, Miller DR, Tseng CL, Tiwari A, Rajan M, Aron D, Pogach L: Failure of ICD-9-CM codes to identify patients with comorbid chronic kidney disease in diabetes. Health Serv Res 2006; 41: 564-80
4. So L, Evans D, Quan H: ICD-10 coding algorithms for defining comorbidities of acute myocardial infarction. BMC Health Serv Res 2006; 6: 161
5. van Walraven C, Austin PC, Manuel D, Knoll G, Jennings A, Forster AJ: The usefulness of administrative databases for identifying disease cohorts is increased with a multivariate model. J Clin Epidemiol 2010; 63: 1332-41
6. Cooke CR, Joo MJ, Anderson SM, Lee TA, Udris EM, Johnson E, Au DH: The validity of using ICD-9 codes and pharmacy records to identify patients with chronic obstructive pulmonary disease. BMC Health Serv Res 2011; 11: 37
7. Lacasse Y, Montori VM, Lanthier C, Maltis F: The validity of diagnosing chronic obstructive pulmonary disease from a large administrative database. Can Respir J 2005; 12: 251-6
8. Quan H, Li B, Saunders LD, Parsons GA, Nilsson CI, Alibhai A, Ghali WA, IMECCHI Investigators: Assessing validity of ICD-9-CM and ICD-10 administrative data in recording clinical conditions in a unique dually coded database. Health Serv Res 2008; 43: 1424-41