

Adaptation of the Charlson Comorbidity Index for Register-Based Research in Sweden

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Purpose: Comorbidity indices are often used to measure comorbidities in register-based research. We aimed to adapt the Charlson comorbidity index (CCI) to a Swedish setting.

Methods: Four versions of the CCI were compared and evaluated by disease-specific experts.

Results: We created a cohesive coding system for CCI to 1) harmonize the content between different international classification of disease codes (ICD-7,8,9,10), 2) delete incorrect codes, 3) enhance the distinction between mild, moderate or severe disease (and between diabetes with and without end-organ damage), 4) minimize duplication of codes, and 5) briefly explain the meaning of individual codes in writing.

Conclusion: This work may provide an integrated and efficient coding algorithm for CCI to be used in medical register-based research in Sweden.

Keywords: Charlson comorbidity score, comorbidity, disease, epidemiology, public health, Sweden

Plain Language Summary

The Charlson co-morbidity index (CCI) is a disease index that was originally created to predict short-term mortality. The CCI is a list of international classification of disease (ICD) codes from the following diseases: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, pulmonary diseases, rheumatic disease, dementia, hemiplegia, diabetes, chronic kidney disease, liver disease, peptic ulcer disease, cancer and HIV/AIDS. Over time the CCI has been increasingly used as a proxy for comorbidity burden and is often used as a co-variate, for instance, in regression models.

There are currently several available versions of the CCI. This creates confusion, increases the risk of mistakes and requires individual researchers to spend considerable time examining included codes.

In this study, we reviewed the four CCI versions to harmonise them into one version adapted to register-based research in Sweden. When doing so we aimed to delete incorrect codes, better distinguish between mild and moderate-severe disease, as well as to minimise the duplication of codes. Finally, we provide explanations of all included ICD codes.

Introduction

Comorbidities often play an important role in health outcomes and survival. They may also influence the relationship between various exposures and other health outcomes as well as quality of life for a given condition. In epidemiology, two main approaches to adjust for comorbidity can be discerned: (I) adjusting for separate disorders or (II) creating a numeric index that can be included in a statistical model.

Numerical indices resulting in scores have the additional advantage that they enable researchers to stratify results according to comorbidity burden. One of the most used scores in the world is the Charlson comorbidity index (CCI).¹ The original paper from 1987 in which Charlson et al describe their approach to measure comorbidity¹ has been cited over 4000 times.

The CCI was created to predict 1-year-mortality but has further been used to predict a range of outcomes.^{2,3} This numerical score is also used to adjust for comorbidity.^{4,5} The original CCI assigned different scores for different comorbidities, ranging from 1 point for each of myocardial infarction, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic lung disease, connective tissue disease, ulcer, chronic liver disease, diabetes; 2 points for each of hemiplegia, moderate or severe kidney disease, diabetes with end-organ damage, tumor, leukemia, lymphoma; 3 points for moderate or severe liver disease; and 6 points for tumor metastasis or AIDS.

Over time, the CCI has been modified, revised and simplified, with some versions receiving their own names (Charlson/Deyo,⁶ Charlson/Romano,⁷ Charlson/Manitoba,⁸ Charlson/D'Hoore,⁹ Charlson/Ghali¹⁰ and Charlson/Quan¹¹). These versions often use different models based on weighting of comorbidities.¹² For instance, Quan et al also included leukemia and lymphoma among malignancies¹¹ and widened "hemiplegia" to "paresis/plegia", including conditions affecting symmetrical parts as well as the whole body.

In addition, individual researchers have constructed their own comorbidity indices based on the CCI with the risk of errors entering algorithms. Existing algorithms often contain long lists of international classification of disease (ICD) codes but rarely explain the underlying meaning of individual codes. Finally, although there are algorithms (such as ICD-8, 9 and 10 codes), ICD-7 codes are often missing despite frequent use in epidemiological research in Sweden.

This work sought to adapt the CCI to Swedish settings and the Swedish versions of ICD, including ICD-7.

Methods

We compared four CCI algorithms used in Sweden to suggest one unique system.

We retrieved the coding lists for the Charlson/Quan index¹¹ and compared their ICD codes¹¹ to those of two unofficial CCI versions used in Sweden (one used at Uppsala University^{13,14} based on the Charlson/Quan

index¹¹ and one used at Karolinska Institutet,¹⁵ likely based on the Charlson/Deyo index⁶), and finally, to a Harvard algorithm (ICD-9 and ICD-10) that has previously been applied to Swedish data.¹⁶

Codes from the four systems were listed according to the comorbidity they belonged to (eg, myocardial infarction, rheumatic disease, moderate or severe liver disease) and according to ICD version used. Only the Karolinska Institutet CCI version contained ICD-7 codes.

JFL (first author) and a research assistant added Swedish and English descriptions (eg, ICD-9 250B: "Diabetes med ketoacidosis" in Swedish, "diabetes with ketoacidosis") to all individual codes (Table 1) to facilitate their review.

Disease-specific experts or specialists were then contacted and invited to review the ICD-7, 8, 9 and 10 codes in their field: myocardial infarction (SJ), congestive heart failure (JS), peripheral vascular disease (JFL), cerebrovascular disease (PA), pulmonary disease (ME and BJ), rheumatology (JA), dementia (NLP), hemiplegia (HS), diabetes (JFL), kidney disease (JJC), liver disease (HH), peptic ulcer disease (JFL), cancer (KES), metastatic cancer (KES) and HIV/AIDS (AME). All co-authors were then invited to review the complete Table 1, to offer comments on the coding.

We sought to construct a CCI adapted to Swedish settings and ICD codes based on the Quan version of the Charlson index,¹¹ with the following specific aims: to (I) create a cohesive system in which the contents of ICD-7, 8, 9 and 10 are as similar as possible, (II) delete incorrect codes, (III) better distinguish between mild, moderate or severe disease (and between diabetes with and without end-organ damage), (IV) avoid duplication of codes since this creates a falsely high comorbidity score (eg, if "diabetes with kidney disease" is listed both under diabetes and under kidney disease that will yield points in both categories) and (V) to list codes with Swedish and English explanations to increase the transparency and understanding of the codes (Table 1). Furthermore, we harmonized the content of each disease area, so that the ICD-7, 8, and 10 lists corresponded to the ICD-9 content of the Charlson/Quan index.¹¹

Ethics

Because this study did not involve individual patient data, no ethical approval or informed consent was required under Swedish law.¹⁷

Table 1 Adaptation of the Charlson Comorbidity Index for Register-Based Research in Sweden: International Classification of Disease (ICD) Codes Plus Swedish and English Language Explanations

	ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997-
Myocardial infarction	420.1 (Hjärtinfarkt med eller utan ruptur, myocardial infarction with or without rupture)	410 (Akut hjärtinfarkt, acute myocardial infarction), 411 (Akut/subakut ischemisk hjärtsjukdom, acute/subacute ischemic heart disease) 412.01 (Post-infarkt syndrom med hypertoni, post-infarction syndrome with hypertension) 412.91 (Post-infarkt syndrom utan hypertoni, post-infarction syndrome without hypertension)	410 (Akut hjärtinfarkt, acute myocardial infarction), 412 (Gammal hjärtinfarkt, old myocardial infarction)	I21 (Akut hjärtinfarkt, acute myocardial infarction), I22 (Reinfarkt, re-infarction), I25.2 (Gammal hjärtinfarkt, old myocardial infarction)
Congestive heart failure	422.21 (Hjärtatrofi, myocardial atrophy) 422.22 (Amyloidpåverkat myokard, myocardial amyloid degeneration) 434.1 (Hjärtsvikt, heart failure) 434.2 (Vänstersidig ventrikulär hjärtsvikt, left ventricular heart failure)	425.08 (Kardiomyopati, andra definitioner, cardiomyopathy other definitions) 425.09 (Kardiomyopati UNS, cardiomyopathy unspecified) 427.0 (Hjärtsvikt, heart failure) 427.1 (Akut lungödem, acute pulmonary edema) 428 (Andra myokardinsufficienser, other myocardial insufficiencies)	ICD-9 1987–1996	ICD-10 1997-
			402A (Malign hypertoni med hjärtsjukdom, malignant hypertension with heart disease) 402B (Benign hypertoni med hjärtsjukdom, benign hypertensive heart disease) 402X (Hypertoni, ospecificerad, med hjärtsjukdom, unspecified hypertensive heart disease) 404A (Malign hypertoni med hjärt- och njursjukdom, malignant hypertensive heart and kidney disease) 404B (Benign hypertoni med hjärt- och njursjukdom med hjärtsvikt och njursvikt, benign hypertensive heart and kidney disease with heart failure and kidney failure) 404X (Hypertoni, ospecificerad, med hjärt- och njursjukdom, unspecified Hypertensive heart and kidney disease) 425E (Annan primär kardiomyopati, Other primary cardiomyopathies) 425F (Alkoholkardiomyopati, Alcoholic cardiomyopathy) 425H (Kardiomyopati vid nutritions- och ämnesomsättningsrubning, Nutritional and metabolic cardiomyopathies) 425W (Kardiomyopati vid andra sjukdomar, Cardiomyopathy in other diseases classified elsewhere) 425X (Sekundär kardiomyopati, icke specificerad, Secondary cardiomyopathy, unspecified) 428 (Hjärtsvikt, heart failure)	I11.0 (Hypertoni med hjärtsjukdom, Hypertensive heart disease) I13.0 (Hypertoni med hjärt- och njursjukdom, Hypertensive heart and kidney disease) I13.2 (Hypertensiv hjärt- och njursjukdom med både hjärtsvikt och njursvikt, Hypertensive heart and kidney disease with both (congestive) heart failure and kidney failure) I25.5 (Ischemisk kardiomyopati, Ischaemic cardiomyopathy) I42.0 (Dilaterad kardiomyopati, Dilated cardiomyopathy) I42.6 (Alkoholkardiomyopati, Alcoholic cardiomyopathy) I42.7 (Kardiomyopati orsakad av läkemedel och annan yttre påverkan, Cardiomyopathy due to drugs and other external agents) I42.8 (Andra specificerade kardiomyopati, Other cardiomyopathies) I42.9 (Kardiomyopati, ospecificerad, Cardiomyopathy, unspecified) I43 (Hjärtmuskelsjukdom vid sjukdomar som klassificeras annorstädes, Cardiomyopathy in infectious and parasitic diseases classified elsewhere) I50 (Kronisk hjärtsufficiens, Congestive heart failure)

(Continued)

Table 1 (Continued).

	ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997-
Peripheral vascular disease	450.1 (Arterioskleros med eller utan gangrän, atherosclerosis with or without gangrene) 451 (Icke slyflitisk aortaneurysm eller aorta-ekasi, non sphyilitic aortic aneurysm or ectasia) 453 (Perifer artteriell sjukdom, peripheral arterial disease)	440 (Ateroskleros, Atherosclerosis) 441 (Aortaneurysm med dissektion, aortic aneurysm dissection) 443.1 (Thrombangiitis obliterans, Thrombangiitis obliterans) 443.9 (Fönsterittarsjukan, Intermittent claudication)	440 (Ateroskleros, Atherosclerosis) 441 (Aortaneurysm, aortic aneurysm) 443B (Thrombangiitis obliterans, Thrombangiitis obliterans) 443X (annan sjukdom i perifera kärl, other peripheral vascular disease) 447B (artärstenos, stricture of artery) 557 (kärlsjukdomar i tarmen, vascular disorders of the intestine)	170 (Ateroskleros, Atherosclerosis) 171 (Aortaneurysm, Aortic aneurysm and dissection) 173.1 (Thrombangiitis obliterans, Thrombangiitis obliterans) 173.8 (Andra specificerade sjukdomar i perifera kärl, Other specified peripheral vascular diseases) 173.9 (Perifer vaskulär sjukdom, unspecified) Peripheral vascular disease, unspecified) 177.1 (Artärstriktur, Stricture of artery) 179.0 (Aneurysm i aorta vid sjukdomar som klassificeras annorstädes, Aneurysm of aorta in diseases classified elsewhere) 179.2 (Perifer angopati vid sjukdomar som klassificeras annorstädes, Peripheral angopathy in diseases classified elsewhere) K55 (Kärlsjukdomar i tarmen, vascular disorders of the intestine)
Cerebrovascular disease	330 (Subaraknoidal blödning, subarachnoid hemorrhage) 331 (Hjärnblödning, cerebral hemorrhage) 332 (Hjärnemboli, brain embolism) 333 (Spasm i hjärnartärerna, spasm of the cerebral arteries) 334 (Sjukdomar i hjärnans eller ryggmärgens kärl, diseases of the vessels of the brain or spinal cord)	430 (Subaraknoidalblödning, subarachnoid hemorrhage) 431 (Hjärnblödning, cerebral hemorrhage) 432 (Ocklusion (Emboli, trombos) av precerebrala artärer, occlusion (Embolism, thrombosis) of the precerebral arteries) 433 (Hjärntrombos, cerebral thrombosis) 434 (Hjärnemboli, cerebral embolism) 435 (Transitorisk ischemisk attack, transient ischemic attack) 436 (Akut, ej tillräckligt specificerad cerebrovaskulär sjukdom, acute unspecified cerebrovascular disease) 437 (Utbredd ischemisk cerebrovaskulär sjukdom, Widespread ischemic cerebrovascular disease) 438 (Andra och otillräckligt preciserade cerebrovaskulära sjukdomar, other unspecified cerebrovascular diseases)	430 (Subaraknoidalblödning, subarachnoid hemorrhage) 431 (Hjärnblödning, cerebral hemorrhage) 432 (Annan och ospecificerad intrakraniell blödning, other and unspecified intracranial hemorrhage) 433 (Ocklusion och stenosis av precerebrala artärer, occlusion and stenosis of the precerebral arteries) 434 (Ocklusion av cerebrala artärer, occlusion of the cerebral arteries) 435 (Spasm i cerebralarträr, spasm of cerebral artery) 436 (Akut ofullständigt preciserad cerebrovaskulär sjukdom, Acute incomplete cerebrovascular disease) 437 (Annan och ofullständigt preciserad cerebrovaskulär sjukdom, Other and incompletely specified cerebrovascular disease) 438 (Sena effekter av cerebrovaskulär sjukdom, Late effects of cerebrovascular disease)	G45 (Övergående cerebral ischemi (Otillräcklig blodtillförsel till hjärnan) och besläktade syndrom, Transient cerebral ischaemic attack and related syndromes) I60 (Subaraknoidalblödning, Subarachnoid hemorrhage) I61 (Hjärnblödning, Intracerebral hemorrhage) I62 (Annan icke traumatisk intrakraniell blödning, Other nontraumatic intracranial hemorrhage) I63 (Cerebral infarkt, Cerebral infarction) I64 (Akut cerebrovaskulär sjukdom ej specificerad som blödning eller infarkt, Stroke, not specified as haemorrhage or infarction) I67 (Andra cerebrovaskulära sjukdomar, Other cerebrovascular diseases) I69 (Sena effekter av cerebrovaskulär sjukdom, late complications from cerebrovascular disease)

	ICD-7 up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997-
Chronic obstructive pulmonary disease (COPD)	502 (Kronisk bronkit med emfysem, chronic bronchitis with emphysema) 527.1 (Emfysem utan bronkit, emphysema without bronchitis)	491 (Kronisk bronkit, chronic bronchitis) 492 (Emfysem, emphysema)	491 (Kronisk luftvägssjukdom, chronic bronchitis) 492 (Lungemfysem, emphysema) 496 (Kronisk obstruktiv lungsjukdom som ej klassificeras annorstädes, Chronic obstructive pulmonary disease that is not classified elsewhere)	J43 (Lungemfysem, Emphysema) J44 (Kroniskt obstruktiv lungsjukdom, Other chronic obstructive pulmonary disease)
Other chronic pulmonary disease	501 (Bronkit ospecificerad, unspecified bronchitis) 241 (Asthma, asthma) 523 (Siliikos, silicosis) 524 (Pneumokoniois och professionell lungfibros, pneumoconiosis and professional pulmonary fibrosis) 525 (Annan kronisk interstitiell pneumoni, other chronic interstitial lung disease) 526 (Bronkiektasi, bronchiectasis),	490 (Bronkit ospecificerad, unspecified bronchitis) 493 (Asthma, asthma) 515 (Pneumokoniois genom silikat, Pneumoconiosis Silicos) 516 (Annan pneumokoniois och besläktade sjukdomar, other pneumoconiosis and related diseases) 517 (Annan kronisk interstitiell pneumoni, other chronic interstitial pneumonia) 518 (Bronkiektasi, bronchiectasis)	490 (Bronkit – akut eller kronisk, Bronchitis, not specified as acute or chronic) 493 (Asthma, asthma) 494 (Bronkiektasier, Bronchiectasis) 495 (Extrinsisk allergisk alveolitis, Hypersensitivitetspneumonit) 500 (Pneumokoniois, pneumoconiosis) 501 (Asbestos, Asbestosis) 502 (Pneumokoniois (Dammlunga) orsakad av kisel och andra kiselöreningar än asbest, Pneumoconiosis due to other silica or silicates) 503 (Pneumokoniois (Dammlunga) orsakad av annat oorganiskt damm, Pneumoconiosis due to other inorganic dust) 504 (Lungsjukdom orsakad av inandning av annat damm, Pneumopathy due to inhalation of other dust) 505 (Icke specificerad pneumokoniois (Dammlunga), Pneumoconiosis, unspecified) 506 (Sjukliga tillstånd i luftvägarna orsakade av rök eller ånga, Respiratory conditions due to fumes and vapours) 507 (Pneumonit orsakad av föda eller uppträckt maginnehåll, pneumonitis due to food or vomits) 508 (Lungmanifestationer av yttre orsaker, Pulmonary conditions due to external agents) 516 (Postinflammatorisk lungfibros, post-inflammatory lung fibrosis) 517 (Lungpåverkan vid annan sjukdom t.ex. reumatisk sjukdom och sarcoidos; pulmonary disease due to other disease including rheumatic conditions and sarcoidosis)	J41 (Kronisk bronkit utan luftvägsobstruktion, Chronic bronchitis without airway obstruction) J42 (Icke-specificerad kronisk bronkit, unspecified chronic bronchitis) J45 (Asthma, asthma) J46 (Akut svår astma, Acute severe asthma) J47 (Bronkiektasier, Bronchiectasis) J60 (Pneumokoniois (Dammlunga) orsakad av stenkolssdamm, Coalworker's pneumoconiosis) J61 (Pneumokoniois (Dammlunga) orsakad av asbest och andra mineralfibrer, Pneumoconiosis due to asbestos and other mineral fibres) J62 (Pneumokoniois (Dammlunga) orsakad av damm innehållande kisel, Pneumoconiosis due to dust containing silica) J63 (Pneumokoniois (Dammlunga) orsakad av annat oorganiskt damm, Pneumoconiosis due to other inorganic dusts) J64 (Icke specificerad pneumokoniois (Dammlunga), Unspecified pneumoconiosis) J65 (Pneumokoniois (Dammlunga) förenad med tuberkulos, Pneumoconiosis associated with tuberculosis) J66 (Luftvägssjukdom orsakad av specificerat organiskt damm, Airway disease due to specific organic dust) J67 (Hypersensitivitetspneumonit (spridda, icke infektionsbetingade inflammatoriska förändringar i lungorna) orsakad av organiskt damm, Hypersensitivity pneumonitis due to organic dust) J68 (Sjukliga tillstånd i lungorna orsakade av kemikalier; gaser, rök och ånga, Respiratory conditions due to chemicals, gases, fumes and vapours) J69 (Pneumonit orsakad av fast eller flytande ämne, pneumonitis due to solid or fluid substance) J70 (Sjukliga tillstånd i lungorna av andra yttre orsaker, Respiratory conditions due to other external agents)

(Continued)

Table 1 (Continued).

	ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997–
Rheumatic disease	710.0 (Dermatomyositis eller sclerodermi, dermatomyositis or scleroderma) 722.0 (Reumatoid artrit, reumatoid arthritis) 722.23 (Ankyloserande spondylit, ankylosing spondylitis) 456.0–456.3 (Temporalarterit, SLE, Takayasu, temporal arteritis; giant cell arteritis), SLE, Takayasu arteritis)	446 (Polyarteritis nodosa) 696.00 (psoriasis-artrit, psoriatic arthritis) 712.0–712.3 (Reumatoid artrit, reumatoid arthritis and ankylosing spondylitis) 712.5 (Ankyloserande spondylit, ankylosing spondylitis) 716 (Dermatomyositis och polymyositis, dermatomyositis and polymyositis) 734.0 (Systemisk skleros, systemic sclerosis) 734.1 (SLE) 734.9 (Sjögrens syndrom, Sjögren syndrome)	446 (Polyarteritis nodosa) 696A (psoriasis-artrit, psoriatic arthritis) 710A-E (SLE, sklerodermi, Sjögrens syndrom, dermatomyositis, polymyositis; SLE, scleroderma, sicca syndrome, dermatomyositis and polymyositis) 714 (Reumatoid artrit, reumatoid arthritis including juvenile idiopathic arthritis) 719D (Palindrom reumatoid artrit; palindromic reumatoid arthritis) 720 (Ankyloserande spondylit, ankylosing spondylitis) 725 (Polymyalgia rheumatica, temporal arteritis)	M05; M06, M12.3 (Reumatoid artrit, reumatoid arthritis) M07.0–3 (Psoriasis-artrit, psoriatic arthritis) M08 (Juvenil idiopatisk artrit, juvenile idiopathic arthritis) M13 (Polyartrit, poly arthritis) M30 (Polyarteritis nodosa) M31.3-M31.6 (Andra nekrotiserande vaskulopatier, Necrotizing vasculitides including giant cell arteritis) M32 (SLE) M33 (Dermatopolymyositis, Dermato- and polymyositis) M34 (Systemisk skleros, Systemic sclerosis) M35.0 (Sjögrens syndrom, Sjögren syndrome) M35.1 (Andra overlap-syndrom, Other overlap syndromes) M35.3 (Polymyalgia rheumatica, Polymyalgia rheumatica) M45–46 (Ankyloserande spondylit, ankylosing spondylitis)
Dementia	304 (Senil psykos, senile psychosis) 305 (Alzheimers sjukdom, Alzheimers disease)	290 (Senil psykos, senile psychosis)	290 (Olika typer av demens inklusive alzheimers, various forms of dementia including alzheimers disease) 294B (Demens på grund av somatisk sjukdom; dementia due to somatic disease) 331A-C, 331X (Presenil och senil degeneration inclusive Pick's sjukdom; presenile/senile dementia including Pick's disease)	F00 (Demens vid Alzheimers sjukdom, Dementia in Alzheimer's disease) F01 (Vaskulär demens, Vascular dementia) F02 (Demens vid andra sjukdomar som klassificeras annorstädes, Dementia in other diseases classified elsewhere) F03 (Ospecificerad demens, Unspecified dementia) F05.1 (Delirium med underliggande demenssjukdom, Delirium superimposed on dementia) G30 (Alzheimers sjukdom, Alzheimer's disease) G31.1 (Senil degeneration av hjärnan som ej klassificeras annorstädes, Senile degeneration of brain, not elsewhere classified) G31.9 (Degenerativ sjukdom i nervsystemet, degenerative disease of the nervous system)

	ICD-7 up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997-
Hemiplegia, tetraplegia	351–352 (Paralysis cerebri, cerebral palsy) 357.00 (Ataxia familiaris, Hereditary spastic paraplegia)	343–44 (Paralysis cerebri, cerebral palsy)	342 (Ensidig förlämnig Hemiplegia) 343 (Cerebral pares, cerebral palsy) 344A-F (Paralysis cerebri alla, Andra förlämningsyndrom från monoplegi till tetraplegi, Monoplegia ranging to tetraplegia)	G11.4 (Hereditär spastisk paraplegi, hereditary spastic paraplegia) G80 (Cerebral pares, cerebral palsy) G81 (Ensidig förlämnig, hemiplegia) G82 (parapares/tetrapares, paraplegia and tetraplegia) G83.0-G83.3 (Andra förlämningsyndrom, Monoplegia to tetraplegia) G83.8 (Andra specificerade förlämningsyndrom, tetraplegia)
Diabetes	260.09 (Diabetes utan komplikationer, diabetes mellitus without complications)	250.00 (Diabetes utan komplikationer, diabetes mellitus without complications) 250.07 (Diabeteskoma, diabetic coma) 250.08 (Diabetes med andra komplikationer, diabetes with other complications)	250A (Diabetes, diabetes mellitus) 250B (Diabetes med ketoacidosis, diabetes with ketoacidosis) 250C (Diabetes med koma, diabetes with coma)	E10.0 (Insulinberoende diabetes med koma, Diabetes mellitus with coma) E10.1 (Insulinberoende diabetes med ketoacidosis, Diabetes mellitus with ketoacidosis) PLUS other forms of diabetes without End-stage organ damage E11.0-E11.1 E12.0-E12.1 E13.0-E13.1 E14.0-E14.1

(Continued)

Table 1 (Continued).

	ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997–
Diabetes with end organ damage	260.20 (Diabeteskatarakt, diabetic cataracts) 260.21 (Diabetesretinopati, diabetic retinopathy) 260.29 (Diabetes med andra ögonkomplikationer, diabetes mellitus with other eye complications) 260.30 (Diabetesnefropati, diabetic nephropathy) 260.40 (Diabetespolyneurit, diabetic polyneuropathy) 260.49 (Diabetesneuropati, diabetic neuropathy) 260.99 (Diabetes mellitus med flera komplikationer, diabetes mellitus with multiple complications)	250.01 (Diabeteskatarakt, diabetic cataracts) 250.02 (Diabetesretinopati, diabetic retinopathy) 250.03 (Diabetes med andra ögonkomplikationer, diabetes mellitus with other eye complications) 250.04 (Diabetesnefropati, diabetic nephropathy) 250.05; (Diabetespolyneurit, diabetic polyneuropathy)	250D (Diabetes med njurkomplikation, diabetes with kidney complications) 250E (Diabetes med ögonkomplikation, Diabetes with eye manifestations) 250F (Diabetes med neurologisk komplikation, Diabetes with neurological manifestations) 250G (Diabetes med perifer cirkulationsrubbing, Diabetes with peripheral vascular disorders)	E10.2 (Insulinberoende diabetes med njurkomplikationer, Diabetes mellitus renal complications) E10.3 (Insulinberoende diabetes med ögonkomplikationer, Diabetes mellitus with eye complications) E10.4 (Insulinberoende diabetes med neurologiska komplikationer, Diabetes mellitus with neurological complications) E10.5 (Insulinberoende diabetes med perifer cirkulationsrubbing, Diabetes mellitus with peripheral vascular complications) E10.7 (Insulinberoende diabetes med multipla komplikationer, Diabetes mellitus with multiple complications) (AND (other forms of diabetes with same End-stage organ damage)) E11.2-E11.7 E12.2-E12.7 E13.2-E13.7 E14.2-E14.7

	ICD-7 up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997–
Moderate or severe kidney disease	592 (Kronisk nefrit, chronic nephritis) 593 (Nefrit utan uppgift om akut eller kroniskt fall, nephritis without information on whether it is chronic or acute) 792 (Uremi, uremia)	582 (Kronisk nefrit med uremi, chronic nephritis with uremia) 583 (Nefrit, nephritis) 584 (Njurskleros, nephrosclerosis) 792 (Uremi, uremia) 593.0 (Njurorsakad skelettsjukdom, renal rickets) 403.99 (Essentiell hypertoni med njursjukdom, essential hypertension with kidney disease) 404.99 (Essentiell hypertoni med (Både) hjärt- och njursjukdom, essential hypertension with both heart and kidney disease) 792.99 (Uremi, uremia) Y29.01 (Dialys, dialysis)	403A (Malign hypertoni med njursjukdom, malignant hypertensive kidney disease) 403B (Benign hypertoni med njursjukdom, Hypertensive kidney disease) 403X (Hypertoni, ospecificerad, med njursjukdom, Hypertensive kidney disease) 582 (Kronisk glomerulonefrit, chronic glomerulonephritis) 583 (Nefrit eller nefropati med påvisade anatomisk/patologiska förändringar, nephritis or nephropathy with confirmed anatomical or histopathological changes) 585 (Kronisk njursvikt, chronic kidney failure) 586 (Icke specificerad njursvikt, unspecified kidney failure) 588A (Renal osteodystrofi, Renal osteodystrophy) V42A (Njurtransplantation, kidney transplantation) V45B (Behov av återkommande njurdialys, Kidney dialysis) V56 (Eftervård med återkommande dialys, Aftercare involving intermittent dialysis)	N03.2-N03.7 (Kronisk glomerulonefrit – ej minimal change eller fokal, Chronic glomerulonephritis – not minimal change or focal) N05.2-N05.7 (Icke-specificerad glomerulonefrit – ej minimal change eller fokal, Unspecified glomerulonephritis – not minimal change or focal) N11 (Kronisk pyelonefrit, chronic pyelonephritis) N18 (Kronisk njursvikt, Chronic kidney failure) N19 (Njursvikt, icke specificerad som akut eller kronisk, Unspecified kidney failure) N25.0 (Renal osteodystrofi orsakade av nedsatt funktion i njurtubuli, Renal osteodystrophy resulting from impaired renal tubular function) I12.0 (Hypertensiv njursjukdom med njursvikt, Hypertensive kidney disease with kidney failure) I13.1 (Hypertensiv hjärt- och njursjukdom med njursvikt, Hypertensive heart and kidney disease with kidney failure) Q61.1-Q61.4 (Autosomal polycystisk njursjukdom, autosomal polycystic kidney disease) Z49 (Förberedande vård för dialys/ Extrakorporal D/Annan D, Preparatory care for dialysis, Extracorporeal/Other dialysis) Z94.0 (Njurtransplanterad, kidney transplant) Z99.2 (Berorande av njurdialys, need for kidney dialysis)

(Continued)

Table 1 (Continued).

	ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997-
Mild liver disease	581 (Livercirrhosis, liver cirrhosis)	070 (Virushepatitis, viral hepatitis) 571 (Livercirrhosis, liver cirrhosis) 573 (Hepatitis, hepatitis)	070 (Virushepatitis, viral hepatitis) 571C (Livercirrhosis, liver cirrhosis) 571E (Chronic hepatitis) 571F (Livercirrhosis without mention of alcohol) 573 (Hepatitis, unspecified hepatitis)	B15-B19 (Virushepatitis, viral hepatitis) K70.3 (Livercirrhosis, liver disease, unspecified) K73 (Chronic hepatitis, not elsewhere classified) K74.6 (Livercirrhosis, liver cirrhosis) K70.3 (Livercirrhosis, liver cirrhosis) K75.4 (Autoimmune hepatitis, autoimmune hepatitis)
Moderate or severe liver disease	462.1 (Esophageal varices, esophageal varices)	785.3 (+Any code for mild liver disease in combination with ascites) 456.0 (Esophageal varices, bleeding or not bleeding) 571.9 (Livercirrhosis with portal hypertension) 573.02 (Livercirrhosis, Hepatic Encephalopathy)	789F (+Any code for mild liver disease in combination with ascites) 456A (Esophageal varices, bleeding) 456B (Esophageal varices without mention of bleeding) 456C (Esophageal varices, liver cirrhosis) 572D (Portal hypertension, Portal hypertension) 572E (Hepatic encephalopathy, Hepatic encephalopathy) 572C (Livercirrhosis, Hepatic Encephalopathy)	R18 (+Any code for mild liver disease in combination with ascites) I85.0 (Esophageal varices, bleeding) I85.9 (Esophageal varices without bleeding) I82 (Esophageal varices, liver cirrhosis) I83 (Esophageal varices, liver cirrhosis) I84 (Esophageal varices, liver cirrhosis) I85 (Esophageal varices, liver cirrhosis) I86 (Esophageal varices, liver cirrhosis) I87 (Esophageal varices, liver cirrhosis) I88 (Esophageal varices, liver cirrhosis) I89 (Esophageal varices, liver cirrhosis) I90 (Esophageal varices, liver cirrhosis) I91 (Esophageal varices, liver cirrhosis) I92 (Esophageal varices, liver cirrhosis) I93 (Esophageal varices, liver cirrhosis) I94 (Esophageal varices, liver cirrhosis) I95 (Esophageal varices, liver cirrhosis) I96 (Esophageal varices, liver cirrhosis) I97 (Esophageal varices, liver cirrhosis) I98 (Esophageal varices, liver cirrhosis) I99 (Esophageal varices, liver cirrhosis)
(Peptic) Ulcer disease	540 (Gastric ulcer) 541 (Duodenal ulcer) 542 (Gastrojejunal ulcer, gastrojejunal ulcer)	531 (Gastric ulcer) 532 (Gastric ulcer) 533 (Gastric ulcer) 534 (Gastrojejunal ulcer, gastrojejunal ulcer)	531 (Gastric ulcer) 532 (Gastric ulcer) 533 (Gastric ulcer) 534 (Gastrojejunal ulcer, gastrojejunal ulcer)	K25 (Gastric ulcer) K26 (Gastric ulcer) K27 (Gastric ulcer) K28 (Gastrojejunal ulcer, gastrojejunal ulcer)

	ICD-7 up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997–
Any malignancy, including leukemia and lymphoma*	140-204, not 191	140-209, not 173, 175-179 or 208	140-208	C00-C97, not C87
	140 (Tumör på läpp, neoplasm of the lip)	140 (Malign tumör på läpp, malignant neoplasm of the lip)	140 (Malign tumör i läpp, Malignant neoplasm of the lip)	C00 (Malign tumör i läpp, Malignant neoplasm of the lip)
	141 (Tumör på tungan, neoplasm of the tongue)	141 (Malign tumör på tungan, malignant neoplasm of the tongue)	141 (Malign tumör i tungan, Malignant neoplasm of the tongue)	C01 (Malign tumör i tungbasen, Malignant neoplasm of the base of tongue)
	142 (Tumör på öronspottskörtel, malignant neoplasm of the parotid gland)	142 (Malign tumör i spottkörtel, malignant neoplasm of the salivary gland)	142 (Malign tumör i de stora spottkörtarna, Malignant neoplasm of the major salivary glands)	C02 (Malign tumör i annan och icke specificerad del av tungan, Malignant neoplasm of other and unspecified parts of tongue)
	143 (Tumör i munbotten, malignant neoplasm of the mouth floor)	143 (Malign tumör i tandköttet, malignant neoplasm of the gums)	143 (Malign tumör i tandköttet, Malignant neoplasm of the gum)	C03 (Malign tumör i tandköttet, Malignant neoplasm of the gum)
	144 (Tumör i munnen, malignant neoplasm of the mouth)	144 (Malign tumör i munbotten, malignant neoplasm of the floor of mouth)	144 (Malign tumör i munbotten, Malignant neoplasm of the floor of mouth)	C04 (Malign tumör i munbotten, Malignant neoplasm of the floor of mouth)
	145 (Tumör i tonsill, malignant neoplasm of the tonsil)	145 (Malign tumör i munnen, andra delar eller UNS, malignant neoplasm of the mouth, other parts)	145 (Malign tumör i annan och icke specificerad del av munhålan, Malignant neoplasm of other and unspecified parts of mouth)	C05 (Malign tumör i gom, Malignant neoplasm of the palate)
	146 (Tumör i nasofarynx, malignant neoplasm of the nasopharynx)	146 (Malign tumör i mellansvalget, malignant neoplasm of the oropharynx)	146 (Malign tumör i orofarynx, Malignant neoplasm of the oropharynx)	C06 (Malign tumör i annan och icke specificerad del av munhålan, Malignant neoplasm of other and unspecified parts of mouth)
	147 (Tumör i hypofarynx, malignant neoplasm of the hypopharynx)	147 (Malign tumör i nässvalgrummet, malignant neoplasm of the nasopharynx)	147 (Malign tumör i rinofarynx, Malignant neoplasm of the nasopharynx)	C07 (Malign tumör i parotiskörtel, Malignant neoplasm of the parotid gland)
	148 (Tumör i farynx, malignant neoplasm of the pharynx)	148 (Malign tumör i svalget bakom struphuvudet, Malignant neoplasm of the pharynx behind the larynx)	148 (Malign tumör i hypofarynx, Malignant neoplasm of the hypopharynx)	C08 (Malign tumör i andra och icke specificerade stora spottkörtlar, Malignant neoplasm of other and unspecified major salivary glands)
	150 (Tumör i esofagus, malignant neoplasm of the oesophagus)	149 (Malign tumör i svalget UNS, malignant neoplasm of the pharynx)	149 (Malign tumör i annan och ofullständigt angiven lokalisation)	C09 (Malign tumör i tonsill, Malignant neoplasm of the tonsil)
	151 (Tumör i ventrikel, malignant neoplasm of the stomach)	150 (Malign tumör i matsrupen, Malignant neoplasm of the oesophagus)	150 (Malign tumör i läpp, munhåla och svalg, Malignant neoplasm of other and ill-defined sites within the lip, oral cavity and pharynx)	C10 (Malign tumör i orofarynx (Mellansvalget), Malignant neoplasm of the oropharynx)
	152 (Duodenaltumör, malignant neoplasm of the small intestine, including the duodenum)	151 (Malign tumör i magsäcken, Malignant neoplasm of the stomach)	150 (Malign tumör i matsrupen, Malignant neoplasm of the oesophagus)	C11 (Malign tumör i rinofarynx (övre svalgrummet), Malignant neoplasm of the nasopharynx)
	153 (Tumör i tjocktarmen, malignant neoplasm of the large intestine)	152 (Malign tumör i tunntarm, inklusive tolvfingertarmen, Malignant neoplasm of the small intestine, including the duodenum)	151 (Malign tumör i magsäcken, Malignant neoplasm of the stomach)	C12 (Malign tumör i fossa piriformis, Malignant neoplasm of the pyriform sinus)
	154 (Tumör i rektum, malignant neoplasm of the rectum)	153 (Malign tumör i grovtarmen exklusive ändtarmen, malignant neoplasm of large intestine, excluding the rectum)	152 (Malign tumör i tunntarmen inklusive tolvfingertarmen, Malignant neoplasm of the small intestine, including the duodenum)	C13 (Malign tumör i hypofarynx (svalget i höjd med struphuvudet), Malignant neoplasm of the hypopharynx)

(Continued)

Table 1 (Continued).

	ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997-
	155 (Tumör i lever, malignant neoplasm of the liver) 157 (Tumör i pankreas, malignant neoplasm of the pancreas) 158 (Tumör i peritoneum, malignant neoplasm of the peritoneum) 159 (Tumör i digestionsorganen, malignant neoplasm of the digestive organ) 160 (Tumör i näshålan, malignant neoplasm of the nasal cavity) 161 (Tumör i larynx, malignant neoplasm of the larynx) 162 (Tumör i trakea, malignant neoplasm of the trachea) 163 (Tumör i lunga, malignant neoplasm of the lung) 164 (Tumör i mediastinum, malignant neoplasm of the mediastinum) 170 (Tumör i bröst, malignant neoplasm of the breast) 171 (Tumör i uterus-halsen, malignant neoplasm of the uterine cervix) 172 (Tumör i corpus uteri, Malignant neoplasm in the uterine corpus)	154 (Malign tumör i ändtarmen och förbindelsen ändtarm-sigmoideum, malignant neoplasm of the rectum and the junction between rectum and sigmoid colon) 155 (Primär malign tumör i levern och intrahepatiska gallvägarna, Primary malignant neoplasm of the liver and intra-hepatic biliary tract) 156 (Malign tumör i gallblåsa och gallvägar, Malignant neoplasm of the gallbladder and biliary tract) 157 (Malign tumör i bukspottkörteln, Malignant neoplasm of the pancreas) 158 (Malign tumör i bukhinnan och bakomliggande vävnader, Malignant neoplasm of the peritoneum and underlying tissues) 159 (Malign tumör i digestionsorgan UNS, malignant neoplasm of the digestive organs) 160 (Malign tumör i respirationssystemet, Malignant neoplasm of the respiratory system) 161 (Malign tumör i struphuvudet, Malignant neoplasm of the larynx) 162 (Malign (primär) tumör i trakea, bronk och lunga, Malignant (primary) malignant neoplasm of the trachea, bronchus and lung) 163 (Malign (primär) tumör i andra och ospecificerade respirationsorgan, Malignant (primary) malignant neoplasm of other and unspecified respiratory organs) 170 (Malign tumör i ben, bindväv, hud och bröstkörtel, Malignant neoplasm of the bone, connective tissue, skin and mammary gland) 171 (Malign tumör i bindväv och annan mjuk vävnad, Malignant neoplasm of the connective tissue and other soft tissue)	153 (Malign tumör i tjocktarmen, Malignant neoplasm of the large intestine) 154 (Malign tumör i ändtarmen, rektosigmoidala gränssonen och anus, Malignant neoplasm of the rectum, rectosigmoid junction and anus) 155 (Malign tumör i levern och intrahepatiska gallgångarna, Malignant neoplasm of the liver and intrahepatic bile ducts) 156 (Malign tumör i gallblåsan och extrahepatiska gallgångarna, Malignant neoplasm of the gallbladder and extrahepatic bile ducts) 157 (Malign tumör i bukspottkörteln, Malignant neoplasm of the pancreas) 158 (Malign tumör i bukhinnan och retroperitonealrummet, Malignant neoplasm of the retroperitoneum and peritoneum) 159 (Malign tumör med annan och ofullständigt angiven lokalisation i matsmältningsorganen och bukhinnan, Malignant neoplasm of other and ill-defined sites within the digestive organs and peritoneum) 160 (Malign tumör i näshåla, mellanöra och näsans bihålor, Malignant neoplasm of the nasal cavities, middle ear and accessory sinuses) 161 (Malign tumör i struphuvudet, Malignant neoplasm of the larynx) 162 (Malign tumör i luftstrupen, luftrör och lunga, Malignant neoplasm of the trachea, bronchus and lung) 163 (Malign tumör i lungsäcken, Malignant neoplasm of the pleura) 164 (Malign tumör i tymus (Brässen), hjärtat och mediastinum, Malignant neoplasm of the thymus, heart and mediastinum)	C14 (Malign tumör med annan och ofullständigt angiven lokalisation i läpp, munhåla och svalg, Malignant neoplasm of other and ill-defined sites in the lip, oral cavity and pharynx) C15 (Malign tumör i matsstrupen, Malignant neoplasm of the oesophagus) C16 (Malign tumör i magsäcken, Malignant neoplasm of the stomach) C17 (Malign tumör i tunntarmen, Malignant neoplasm of the small intestine) C18 (Malign tumör i tjocktarmen, Malignant neoplasm of the large intestine) C19 (Malign tumör i rektosigmoidala gränssonen, Malignant neoplasm of the rectosigmoid junction) C20 (Malign tumör i ändtarmen, Malignant neoplasm of the rectum) C21 (Malign tumör i anus och analkanalen, Malignant neoplasm of the anus) C22 (Malign tumör i levern och intrahepatiska gallgångarna, Malignant neoplasm of the liver and intrahepatic bile ducts) C23 (Malign tumör i gallblåsan, Malignant neoplasm of the gallbladder) C24 (Malign tumör i andra och icke specificerade delar av gallvägarna, Malignant neoplasm of other and unspecified parts of biliary tract) C25 (Malign tumör i pankreas, Malignant neoplasm of the pancreas)

173 (Tumör i annan del of uterus, malignant neoplasm of other part of uterus)	172 (Malignant melanom i huden, Malignant melanoma of the skin)	165 (Malign tumör med andra och ofullständigt angivna lokalisationer i andningsorganen och brösthåls organ, Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs)	C26 (Malign tumör med annan och ofullständigt angiven lokalisatation i
174 (Tumör i uterus, malignant neoplasm of the uterus)	174 (Malign tumör i bröstkörteln, Malignant neoplasm of the mammary gland)	170 (Malign tumör i ben och ledbrosk, Malignant neoplasm of the bone and articular cartilage)	Matsmältningsorganen, Malignant neoplasm of other and ill-defined digestive organs)
175 (Tumör i ovarium, malignant neoplasm of the ovary)	180 (Malign tumör i urogenitalorganen, Malignant neoplasm of the urogenital organs)	171 (Malign tumör i bindväv och annan mjukvävnad, Malignant neoplasm of connective and other soft tissue)	C30 (Malign tumör i näshåla och mellanöra, Malignant neoplasm of the nasal cavity and middle ear)
176 (Tumör i vulva, malignant neoplasm of the vulva)	181 (Chorioepitheliom, chorioepithelioma)	172 (Malignt melanom (pigmentsvulst) i huden, Malignant melanoma of skin)	C31 (Malign tumör i näsans bihålor, Malignant neoplasm of the accessory sinuses)
177 (Tumör i prostata, malignant neoplasm of the prostate)	182 (Malign tumör i uterus med annan lokalisatation, Malignant neoplasm of the uterus with other location)	173 (Andra maligna tumörer i huden, Other malignant neoplasm of the skin)	C32 (Malign tumör i struphuvudet, Malignant neoplasm of the larynx)
178 (Tumör i testikel, malignant neoplasm of the testicle)	183 (Malign tumör i ovarium, äggledare och breda ligamentet, Malignant neoplasm of the ovary, fallopian tubes and broad ligament)	174 (Malign tumör i kvinnlig bröstkörtel, Malignant neoplasm of the female breast)	C33 (Malign tumör i luftstrupen, Malignant neoplasm of the trachea)
179 (Tumör i manliga genitalorganen, malignant neoplasm of the male genital organ)	184 (Malign tumör i kvinnliga genitalorganen, annan lokalisatation eller UNS, Malignant neoplasm of the female genital organs, other location)	175 (Malign tumör i manlig bröstkörtel, Malignant neoplasm of the male breast)	C34 (Malign tumör i bronk och lunga, Malignant neoplasm of the bronchus and lung)
180 (Tumör i njure, malignant neoplasm of the kidney)	185 (Malign tumör i prostata, Malignant neoplasm of the prostate)	179 (Malign tumör i livmodern med icke specificerad lokalisatation, Malignant neoplasm of the uterus, part unspecified)	C37 (Malign tumör i tymus, Malignant neoplasm of the thymus)
181 (Tumör i urinblåsan, malignant neoplasm of the bladder)	186 (Malign tumör i testikel, Malignant neoplasm of the testicle)	180 (Malign tumör i livmodernhalsen, Malignant neoplasm of the cervix uteri)	C38 (Malign tumör i hjärta, mediastinum (Lungmellanrummet) och lungsäcken, Malignant neoplasm of heart, mediastinum and pleura)
190 (Melanoma på läpp, melanoma on lip)	187 (Malign tumör i annat manligt genitalorgan eller UNS, Malignant neoplasm of other male genital organ)	181 (Malign tumör i moderkakan, Malignant neoplasm of the placenta)	C39 (Maligna tumörer med annan och ofullständigt angiven lokalisatation i
192 (Ögontumör, malignant neoplasm of the eye)	188 (Malign tumör i urinblåsan, Malignant neoplasm of the bladder)	182 (Malign tumör i livmoderkroppen, Malignant neoplasm of the body of uterus)	andningsorganen och brösthåls organ, Malignant neoplasm of other and ill-defined sites in the respiratory system and intrathoracic organs)
193 (Hjärtumör, malignant neoplasm of the brain)	189 (Malign tumör i andra och icke specificerade urinorgan, Malignant neoplasm of other and unspecified urinary organs)	183 (Malign tumör i äggstock och andra med livmodern sammanhängande organ, Malignant neoplasm of the ovary and other uterine adnexa)	C40 (Malign tumör i ben och extremitetsledbrosk, Malignant neoplasm of bone and articular cartilage of limbs)
194 (Tumör i sköldkörteln, malignant neoplasm of the thyroid)	190 (Malign tumör på öga, Malignant neoplasm of the eye)	184 (Malign tumör i andra och icke specificerade kvinnliga könsorgan, Malignant neoplasm of other and unspecified female genital organs)	C41 (Malign tumör i ben och ledbrosk med annan och icke specificerad lokalisatation, Malignant neoplasm of bone and articular cartilage of other and unspecified sites)
195 (Tumör i binjure, malignant neoplasm of the adrenal gland)	191 (Malign hjärntumör, Malignant neoplasm of the brain)	185 (Malign tumör i prostata (Blåshalskörteln), Malignant neoplasm of the prostate)	C43 (Malignt melanom i huden, Malignant melanoma of skin)
196 (Tumör i skallens och ansiktets ben, malignant neoplasm of the skull and facial bones)	192 (Malign tumör på andra ställen inom nervsystemet, Malignant tumor elsewhere in the nervous system)	186 (Malign tumör i testikel, Malignant neoplasm of the testis)	C45 (Mesotelom, Mesothelioma)

(Continued)

Table 1 (Continued).

ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997–
197 (Tumör på hals, neoplasm of the neck)	193 (Malign tumör i sköldkörteln, Malignant neoplasm of the thyroid gland)	187 (Malign tumör i penis och andra manliga könsorgan, Malignant neoplasm of the penis and other male genital organs)	C46 (Kaposi sarkom, Kaposi's sarcoma)
200 (Retikelsarkom, reticulosarcoma)	194 (Malign tumör i andra endokrina körtlar, Malignant neoplasm of other endocrine glands)	188 (Malign tumör i urinblåsan, Malignant neoplasm of bladder)	C47 (Malign tumör i perifera nerver och autonoma nervsystemet, Malignant neoplasm of the peripheral nerves and autonomic nervous system)
201 (Lymfogranulomatos, lymphogranulomatosis)	195 (Tumör på ofullständigt angivet ställe, Tumor in incompletely specified place)	189 (Malign tumör i njure samt andra och icke specificerade urinorgan, Malignant neoplasm of the kidney and other and unspecified urinary organs)	C48 (Malign tumör i bukinnan och retroperitonealrummet (utrymmet bakom bukinnan), Malignant neoplasm of the retroperitoneum and peritoneum)
202 (Folikulärt lymfom, follicular lymphoma)	200 (Tumörer i lymfatiskt och blodbildande vävnad, Tumors in lymphatic and blood-forming tissue)	190 (Malign tumör i öga, Malignant neoplasm of the eye)	C49 (Malign tumör i annan bindväv och mjukvävnad, Malignant neoplasm of other connective and soft tissue)
203 (Multipelt myelom, multiple myeloma)	201 (Malign lymfogranulomatos, Malignant lymphogranulomatosis)	191 (Malign tumör i hjärnan, Malignant neoplasm of the brain)	C50 (Malign tumör i bröstkörtel, Malignant neoplasm of the breast)
204 (Akut lymfatisk leukemi, acute lymphatic leukemia)	202 (Andra tumörer i lymfatiskt vävnad, Other tumors in lymphatic tissue)	192 (Malign tumör i andra och icke specificerade delar av nervsystemet, Malignant neoplasm of other and unspecified parts of nervous system)	C51 (Malign tumör i vulva, Malignant neoplasm of the vulva)
	203 (Multipelt myelom, multiple myeloma)	193 (Malign tumör i tyreoidea (sköldkörteln), Malignant neoplasm of the thyroid gland)	C52 (Malign tumör i vagina, Malignant neoplasm of the vagina)
	204 (Lymfatisk leukemi, Lymphatic leukemia)	194 (Malign tumör i andra endokrina körtlar och därmed	C53 (Malign tumör i livmoderhalsen, Malignant neoplasm of the cervix uteri)
	205 (Myelisk leukemi, Myeloid leukemia)	besläktade vävnader, Malignant neoplasm of other endocrine glands and related structures)	C54 (Malign tumör i livmoderkroppen, Malignant neoplasm of the corpus uteri)
	206 (Monocytleukemi, monocytic leukemia)	195 (Malign tumör med annan och ofullständigt angiven lokalisation, Malignant neoplasm of other and ill-defined sites)	C55 (Malign tumör i livmodern med icke specificerad lokalisation, Malignant neoplasm of the uterus, part unspecified)
	207 (Akut leukemi och LNS, Other leukemia)	200 (Non-Hodgkin-lymfom, non-hodgkin lymphoma)	C56 (Malign tumör i äggstock, Malignant neoplasm of the ovary)
	209 (Myelofibros, myelofibrosis)	201 (Hodgkins sjukdom, Hodgkin lymphoma)	C57 (Malign tumör i andra och icke specificerade kvinnliga könsorgan, Malignant neoplasm of other and unspecified female genital organs)
		202 (Annan malign tumör i lymfoid och histiocytisk vävnad, Other malignant neoplasm of the lymphoid and histiocytic tissue)	C58 (Malign tumör i moderkakan, Malignant neoplasm of the placenta)
		203 (Multipelt myelom och immunoproliferativa tumörer, Multiple myeloma and immunoproliferative neoplasms)	C60 (Malign tumör i penis, Malignant neoplasm of the penis)
			C61 (Malign tumör i prostata, Malignant neoplasm of the prostate)

204 (Lymfatisk leukemi, Lymphoid leukaemia)	C62 (Malign tumör i testikel, Malignant neoplasm of the testicle)
205 (Myeloisk leukemi, Myeloid leukaemia)	C63 (Malign tumör i andra och icke specificerade manliga könsorgan, Malignant neoplasm of other and unspecified male genital organs)
206 (Monocytleukemi, Monocytic leukaemia)	C64 (Malign tumör i njure med undantag för njurbäcken, Malignant neoplasm of the kidney, except renal pelvis)
207 (Annan specificerad leukemi, Other specified leukaemia)	C65 (Malign tumör i njurbäcken, Malignant neoplasm of the renal pelvis)
208 (Leukemi med icke specificerad celltyp, Leukaemia of unspecified cell type)	C66 (Malign tumör i ureter (urinedare), Malignant neoplasm of the ureter)
	C67 (Malign tumör i urinblåsan, Malignant neoplasm of the bladder)
	C68 (Malign tumör i andra och icke specificerade urinorgan, Malignant neoplasm of other and unspecified urinary organs)
	C69 (Malign tumör i öga och närliggande vävnader, Malignant neoplasm of the eye and adnexa)
	C70 (Malign tumör i centrala nervsystemets hinnor, Malignant neoplasm of the meninges)
	C71 (Malign tumör i hjärnan, Malignant neoplasm of the brain)
	C72 (Malign tumör i ryggmärgen, kranialnerv och andra delar av centrala nervsystemet, Malignant neoplasm of the spinal cord, cranial nerves and other parts of the central nervous system)
	C73 (Malign tumör i tyreoidea, Malignant neoplasm of the thyroid gland)
	C74 (Malign tumör i binjure, Malignant neoplasm of the adrenal gland)
	C75 (Malign tumör i andra endokrina körtlar och därmed besläktade vävnader, Malignant neoplasm of the other endocrine glands and related structures)
	C76 (Malign tumör med annan och ofullständigt angiven lokalisation, Malignant neoplasm of other and ill-defined sites)
	C81 (Hodgkins sjukdom, Hodgkin lymphoma)
	C82 (Follikulärt non-Hodgkin-lymfom (B-cell), Follicular (nodular) non-Hodgkin lymphoma)

(Continued)

Table 1 (Continued).

	ICD-7 Up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997-
				C83 (Diffust non-Hodgkin-lymfom (B-celstyp), Diffuse non-Hodgkin lymphoma) C84 (Perifera och kutana T-cellslymfom, Peripheral and cutaneous T-cell lymphomas) C85 (Andra och icke specificerade typer av non-Hodgkin-lymfom, Other and unspecified types of non-Hodgkin lymphoma) C86 (Aggressivt T-cells-lymfom, Aggressive T-cell lymphoma) C88 (Maligna immunoproliferativa sjukdomar, Malignant immunoproliferative diseases) C90 (Plasmacellstumörer, Multiple myeloma and malignant plasma cell neoplasms) C91 (Lymfatiska leukemier, Lymphoid leukaemia) C92 (Myeliska leukemier, Myeloid leukaemia) C93 (Monocytleukemier, Monocytic leukaemia) C94 (Andra specificerade leukemier, Other leukaemias of specified cell type) C95 (Leukemi med icke specificerad celltyp, Leukaemia of unspecified cell type) C96 (Övriga och icke specificerade maligna tumörer i lymfoid, blodbildande och besläktad vävnad, Other and unspecified malignant neoplasms of lymphoid, haematopoietic and related tissue) C97 (Flera (primära) maligna tumörer med olika utgångspunkter, Malignant neoplasms of independent (primary) multiple sites)
Metastatic cancer	156.91 (Tumör i levern, malignant neoplasm of the liver) 198 (Tumör i huvudet, ansiktets och halsens lymfkörtlar, malignant neoplasm of the head, face and neck lymph nodes) 199 (Tumör på annat ställe, Malignant neoplasm in other location)	196 (Malign tumör i lymfkörtlar, sekundär eller UNS, Malignant neoplasm of the lymph nodes, secondary) 197 (Sekundär malign tumör i respirationsorganen och digestionsapparaten, Secondary malignant neoplasm of the respiratory and digestive organs) 198 (Annan sekundär malign tumör, other secondary malignant tumor) 199 (Malign tumör på icke angivet ställe, Malignant tumor at unspecified location)	196 (Sekundär och icke specificerad malign tumör i lymfkörtarna, Secondary and unspecified malignant neoplasm of the lymph nodes) 197 (Sekundär malign tumör i andningsorganen och matsmältningsorganen, Secondary malignant neoplasm of the respiratory and digestive organs) 198 (Sekundär malign tumör med andra specificerade lokalisationer, Secondary malignant neoplasm of other specified sites) 199A (Malign tumör utan specificerad lokalisering, Malignant neoplasm without specification of site) 199B (Annan lokalisering, other localisation)	C77 (Sekundär malign tumör (metastas) och icke specificerad malign tumör i lymfkörtlar, Secondary and unspecified malignant neoplasm of the lymph nodes) C78 (Sekundär malign tumör (metastas) i andningsorganen och matsmältningsorganen, Secondary malignant neoplasm of the respiratory and digestive organs) C79 (Sekundär malign tumör (metastas) med andra lokalisationer, Secondary malignant neoplasm of other sites) C80 (Malign tumör utan specificerad lokalisering, Malignant neoplasm without specification of site)

	ICD-7 up to 1968	ICD-8 1969–1986	ICD-9 1987–1996	ICD-10 1997–
HIV/AIDS	not applicable	not applicable	079] (Sjukdom orsakat av HTLV-III virus, disease caused by the HTLV-III virus) 279K (Human immunoblastic virus, Human immunodeficiency virus (HIV) disease)	B20 (Sjukdom orsakad av human immunoblastic virus (HIV) tillsammans med infektions- och parasitsjukdom, Human immunodeficiency virus (HIV) disease resulting in infectious and parasitic disease) B21 (Sjukdom orsakad av human immunoblastic virus (HIV) tillsammans med maligna tumörer, Human immunodeficiency virus (HIV) disease resulting in malignant neoplasms) B22 (Sjukdom orsakad av human immunoblastic virus (HIV) tillsammans med andra specificerade sjukdomar, Human immunodeficiency virus (HIV) disease resulting in other specified diseases) B23 (Sjukdom orsakad av human immunoblastic virus (HIV) tillsammans med andra tillstånd, Human immunodeficiency virus (HIV) disease resulting in other conditions) B24 (Icke specificerad sjukdom orsakad av human immunoblastic virus (HIV), Unspecified human immunodeficiency virus (HIV) disease) F02.4 (Demens vid sjukdom orsakad av human immunoblastic virus (HIV), HIV dementia) O98.7 (HIV som komplicerande faktor hos gravid kvinna, HIV as complicating factor in pregnant woman) R75 (Positivt HIV-test, positive HIV test) Z11.4 (Riktad hälsokontroll avseende human immunoblastic virus (HIV), Health check-up for HIV) Z21.9 (Asymtomatisk infektion med human immunoblastic virus (HIV), asymptomatic HIV infection) Z71.1 (Rådgivning vid HIV, Human immunodeficiency virus (HIV) counseling)

Notes: UNS (Swedish; utan närmare specifikation; English: unspecified). *Does not include non-melanoma skin cancer.

Results

Four coding lists were compared and a new collective list was created (Table 1). Besides adding ICD-7 codes for several conditions, we also list ICD-9 codes with letters rather than digits (Table 1). Below we review the addition and removal of codes based on the above expert review.

Organ-Specific Comments

Myocardial Infarction

We added ICD-8 codes 412,01 and 412,91, representing post-infarction syndrome with and without hypertension. These *post*-infarction codes mean the diagnosis occurred several weeks earlier, leaving no exact date of diagnosis. Other ICD-8 codes, beginning with 412, were not included in our classification because they represent heart atherosclerosis with no infarction.

Heart Failure

We chose not to include cardiomyopathy caused by Chagas disease because of its rarity in Sweden; nor did we include restrictive cardiomyopathy and non-specific rheumatoid heart disease as these conditions rarely cause heart failure. Finally, we chose not to include neonatal heart failure in that the relevance of this for adult heart function is unclear (and the CCI is usually used in studies of adults). The code P29.0 for neonatal heart failure was otherwise included in Quan's enhanced ICD-10, but no corresponding code was listed for Quan's enhanced ICD-9.¹¹ We excluded ICD-8 code 782,40 as it suggests acute (transient) disease rather than the usual heart failure and is typically part of cardiogenic shock. Also, ICD-9 code 414X was omitted as it is not specific enough to qualify as heart failure.

Peripheral Vascular Disease

Neither did we specifically include cerebral aneurysm since it was already included among the cerebrovascular diseases in our classification. Quan et al¹¹ include the ICD-9 code 47.1. This is probably a typo and this code was therefore excluded.

Cerebrovascular Disease

We chose not to include H34 (retinal occlusion). While this condition has similar treatment recommendations to stroke, it is not regarded as stroke in Sweden (as defined by the Swedish Stroke Quality Register¹⁸). We omitted ICD-10 code I65 given that this code (occlusion and stenosis of pre-cerebral arteries) is not conditional on stroke, but should only be used post-transient ischemic

attack (TIA) when carotid stenosis is discovered. Hence, these patients are likely to be discovered through relevant ICD codes for TIA. Moreover, we did not include ICD-10 code I66, given that it is not equal to cerebral infarction. I68 and G46 are only used as secondary diagnoses when other stroke ICD codes have already been used and were thus not included.

Chronic Obstructive Pulmonary Disease (COPD)

We added ICD-7 code 501 (unspecific bronchitis), but only listed ICD-10 codes J41-J42 under "other chronic pulmonary diseases" to minimize duplication.

Other Chronic Pulmonary Diseases (Including Pneumoconiosis and Chronic Respiratory Conditions Due to Fumes and Vapors)

Here, we added the ICD-7 code for asthma (241), but also extended the ICD-7-codes to include not only 523–524 (pneumoconiosis) but also 523–526 (other interstitial lung disorders and bronchiectasis). Similarly, we added the ICD-8-code for bronchiectasis (518).

We did not include pulmonary heart disease because the pathogenesis of this disease is cardiovascular (ICD-9: 416). We chose to include all ICD-9 codes beginning with 506 and 508 (506, respiratory conditions due to fumes and vapors; 508, respiratory conditions due to non-specified external causes), instead of the 506E/508E codes, which are limited to chronic conditions (and similarly for ICD-10 codes J68 and J70).

Rheumatic Disease

We chose not to include myalgia and fibrositis (ICD-7: 726.3) for lack of specificity, or non-specific rheumatic disease (ICD-7: 727) but included 456.0–456.3 (ICD-7) for systemic lupus erythematosus (SLE) and various less common rheumatic disorders.

Chronic interstitial lung disease was moved to the chapter "Other chronic pulmonary diseases". We did not include dermatomyositis that was secondary to cancer (ICD-10: M36.0). Osteoarthritis (ICD-10-codes M15-M19 and equivalent) was not included either.

Dementia

We added vascular dementia from ICD7-10. We did not include dementia secondary to brain tumor (ICD-7: 308) as such conditions should be coded in the cancer chapter. Nor did we include transient dementia due to brain infections (ICD-9: 309) or ICD-8 codes 293,0–1 since they do not represent vascular dementia.

Diabetes

We included different diabetes types, including diabetes with emergency complications that did not automatically cause end-stage kidney disease. We also included diabetes with coma in this category rather than in diabetes with end-organ damage in that coma does not necessarily indicate end-stage organ damage.

Diabetes with End-Organ Damage

We restricted ICD codes to complications. Moreover, “only diabetes” (eg, ICD-7 code 260,09) or “unspecified diabetes” (ICD-8 code 250,00) was not included in the end-organ damage category. Of note is that not all diabetic complications lead to end-stage organ damage. For that reason, our list does not include emergency complications (eg, diabetic ketoacidosis or diabetes with hypoglycemia), even if life-threatening. Nor did we include E10.8-E14.8 (position x.8) as they represent non-specified complications and it is not clear whether such complications are acute or chronic and to what extent they involve end-stage organ damage.

Liver Disease

We included viral hepatitis (independently of chronicity) and autoimmune hepatitis in mild liver disease but did not include other chronic liver diseases as the original CCI only lists “hepatitis”; nor did we include the following liver diseases among moderate or severe liver diseases: other sequelae of chronic liver disease (ICD-9: 572W), or gastric varices (ICD-10: I86.4). ICD codes for cirrhosis without portal hypertension were also defined as mild liver disease (as well as cirrhosis when portal hypertension was not mentioned). When an ICD code for mild liver disease was coded with a code for ascites, we suggest that the patient is reclassified as having moderate or severe liver disease. Additional codes for moderate or severe liver disease encompassed specific codes associated with portal hypertension.

Hemiplegia

The original CCI only included hemiplegia/hemiparesis and not the conditions affecting symmetrical parts (paraplegia/paraparesis) or the whole body (tetraplegia/tetraparesis).¹ In their enhanced ICD-9 and ICD-10 algorithm, Quan et al¹¹ chose to incorporate these conditions and, therefore, we also included their ICD codes. In addition, we decided to include all subcategories of cerebral palsy as many patients have mixed forms and the choice of a subcategory is not always correct. We excluded cauda

equina syndrome and paralysis unspecified as these conditions include diseases with different etiology and degree and nature of disability.

Moderate or Severe Kidney Disease

We chose not to include kidney hyperplasia (ICD-7 code 603) or kidney cysts (ICD-8 code 593.21) because these conditions alone do not necessarily represent moderate or severe kidney disease. We included the ICD-9 code 583 (nephritis). This code does not specify whether the condition is acute or chronic (which is no requirement in the CCI) but requires that anatomical or histopathological changes in the kidney have been confirmed. In contrast, pyelonephritis was not regarded as moderate or severe kidney disease.

Any Malignancy Including Leukemia and Lymphoma

The cancer code list is long and can be summarized with some notable exceptions (Table 1). For instance, Sweden never used codes 175–179 in ICD-8 or C87 in ICD-10. We omitted non-melanoma skin cancer from the Swedish CCI. Finally, the ICD-10 code C86 was added, which represents aggressive T-cell lymphoma.

Cancer Metastases

We assumed that the ICD-9 199 and the ICD-10 C80 codes mostly represent metastatic disease; hence, they were included in our list.

HIV/AIDS

Sweden did not use ICD-9 codes 042–044 to record HIV/AIDS (personal communication, Swedish National Board of Health and Welfare, April 28, 2020). While B23.2 is the most commonly used ICD-10 code for HIV/AIDS, Swedish physicians have also used less common codes to record HIV/AIDS, including having a positive HIV test, encounter for screening for HIV and HIV complicating pregnancy (Table 1).

Scripts in R, SAS and STATA corresponding to the ICD codes in Table 1 can be accessed through Github.com.

Discussion

This paper reviewed four versions of the CCI to create a cohesive Swedish CCI system, spanning ICD-7 to ICD-10 versions.

To make our algorithm more cohesive we both added (eg, asthma) and omitted codes (eg, restrictive cardiomyopathy) to better correlate Swedish coding with the original

Charlson/Quan index.¹¹ Our review efforts also found that over time a number of incorrect ICD codes had been added to various coding lists, including osteoarthritis, which should not be part of the CCI.

We aimed to avoid duplication to reduce the risk of overestimation of comorbidity and inflation of the scoring index. To achieve this result, we listed diabetic nephropathy under “diabetes with end-organ damage” and not under moderate or severe kidney disease. Some may consider this a biological view of comorbidity rather than reflecting the burden of disease. Yet, this way of classifying conditions is most consistent with other versions of the CCI in which the same ICD code should not occur in several disease categories.

While not incorporated into our revised CCI, drugs can also be used to ascertain comorbidity. For instance, ATC codes N06DA02, N06DA04 and N06DX01 are sometimes applied to identify Alzheimer’s disease and A10 diabetes. In Sweden, prescription data (but not hospital-administered drugs) are available through the Swedish Prescribed Drug Register since July 2005.¹⁹

Our intent was not to compare different comorbidity indices given the wealth of papers that have already done so.^{20–24} Neither did we attempt to validate any codes.

We chose to widen “hemiplegia” to “paresis/plegia” because of the similarities concerning both etiologies and degree of disability. Even though the term paresis refers to weakness and the term plegia to a loss of all voluntary movements, the terms are used interchangeably. Cerebral palsy is often referred to as paresis but also plegia. Severe hemiplegia may lead to a higher degree of disability than mild tetraplegia.

Finally, coding is not the only issue when using the CCI or other comorbidity scores. It is also a matter of timing. While most chronic disorders persist throughout life, some do not (eg, cancer may be cured). Researchers will have to consider this aspect.

This paper has some limitations. First, we did not evaluate the predictive value of our suggested CCI, because that is beyond the scope of this paper. However, we hope our work to create an updated more cohesive and useful index, will inspire other researchers to make similar revisions of their own national coding systems, and we encourage future research into the predictive gains of the new index.

Second, while all 16 co-authors were invited to comment on the complete algorithm, different experts can have different understanding of the codes, and we cannot rule

out that a choice of more/other experts could have impacted on our selection of codes.

In conclusion, this extensive work may provide a cohesive coding algorithm for CCI to be used in Swedish settings.

Abbreviations

CCI, Charlson comorbidity index; ICD, International Classification of Disease.

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<https://github.com/bjoroeKI/Charlson-comorbidity-index-revisited>

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