# Cardiac Care Quality Indicators

## General Methodology Notes

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Canadian Institute
for Health Information

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# Purpose

These notes give users the general methodological details behind the Cardiac Care Quality Indicators (CCQI) Report so they can better understand and interpret the results. These notes apply to the most recent release.

Detailed definitions and selection criteria for each indicator are available in [CIHI's Indicator Library](#).

Methodology development is guided by a national expert advisory group composed of cardiac physicians and hospital administrators, as well as representatives from the Canadian Cardiovascular Society and key cardiac and research organizations across Canada.

More information on the CCQI Report is available on our [Cardiac Care web page](#).

If you have any questions about the indicator results or definitions, please write to [cardiacquality@cihi.ca](#).

# Indicators in the CCQI Report

The report includes data on the following 6 indicators and 1 volume measure, with results available at the Canadian, provincial and cardiac care centre levels.

| Category | Indicator/measure |
|---|---|
| Mortality | 30-Day In-Hospital Mortality After PCI |
| | 30-Day In-Hospital Mortality After Isolated CABG |
| | 30-Day In-Hospital Mortality After Isolated AVR |
| | 30-Day In-Hospital Mortality After CABG and AVR |
| Readmission | 30-Day All-Cause Readmission Rate After PCI |
| | 30-Day All-Cause Readmission Rate After Isolated CABG |
| Volume | PCI Volume by Centre (measure, not risk-adjusted) |

**Notes**
PCI: Percutaneous coronary intervention.
CABG: Coronary artery bypass graft.
AVR: Aortic valve replacement.

# Data sources

Hospitals in all jurisdictions (except Quebec) submit acute care and day procedure data to the Discharge Abstract Database (DAD) and/or National Ambulatory Care Reporting System (NACRS) at the Canadian Institute for Health Information (CIHI). Hospitals in Quebec submit data to Maintenance et exploitation des données pour l'étude de la clientèle hospitalière (MED-ÉCHO); MED-ÉCHO data is then submitted to CIHI, which integrates it into the Hospital Morbidity Database (HMDB). There is no comprehensive capture of PCI data in Quebec, so Quebec cannot be included in analyses for in-hospital mortality after PCI, 30-day readmission after PCI and PCI volume by centre. All data used to calculate the CCQI results is referenced from the above data sources.

The methodology used for these indicators is designed to maximize inter-facility comparability, given the characteristics of available Canadian data sets. The indicators are calculated using CIHI's administrative databases, where medical conditions and cardiac interventions are identified with diagnosis/procedure codes (ICD-10-CA[i] and CCI,[ii] versions 2012, 2015 and 2018). There may be differences between the definitions, data sources and extraction procedures that appear in some local, regional/provincial/territorial or hospital reports and those described here.

# General inclusion/exclusion criteria

## Non-clinical inclusion/exclusion criteria*

| Calculation | Criteria |
|---|---|
| Include | • All acute care, day surgery and cardiac catheterization clinic data (DAD, HMDB, NACRS) |
| | • Age at admission 18 years and older |
| | • Valid health card number (HCN)[†] |
| | • Invalid HCN[‡] |
| Exclude | • Records with an invalid date of birth |
| | • Records with an invalid HCN[†] |
| | • Records with an invalid admission date or time[§] |
| | • Records with an invalid discharge date or time** |

**Notes**
* Not applicable to volume measures, with the exception of invalid HCN.
† For Readmission indicators only.
‡ For Mortality indicators and PCI volume measure only.
§ Registration date/time used for NACRS records.
** Disposition date/time used for NACRS records.

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i. ICD-10-CA: International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada.
ii. CCI: Canadian Classification of Health Interventions.

# Clinical exclusion criteria*

Records with the following diagnoses recorded as any diagnosis type:

| Calculation | Criteria | ICD-10-CA codes |
|---|---|---|
| **Exclude** | Pregnancy* | ICD-10-CA codes beginning with O, except for postpartum conditions that have 4 as the 6th digit |
| | | OR |
| | | Z32.1, Z33, Z34.–, Z35.–, Z36.–, Z37.–, A34 |

**Note**
\*  Not applicable to volume measure.

# Record linkage

Records from the various databases are linked to follow patients across a hospitalization episode of care and to identify outcomes following the different cardiac interventions. Encrypted health card number (HCN) and the HCN-issuing province are used for record linkage (linkage keys). The linkage methodology allows for linkage across Canada, with the exception of Quebec and Manitoba due to the submission format of their HCNs. For data submitted by Manitoba, we are unable to link Manitoba residents who are admitted/transferred in and out of Manitoba. For data submitted by Quebec, we are unable to link patients who are admitted/transferred in and out of Quebec.

# Unit of analysis

The unit of analysis is an episode of care or hospitalization episode. An episode of care refers to all contiguous inpatient hospitalizations and day procedure visits. This definition prevents transfers from being considered as 2 separate hospitalizations. To construct an episode of care, a transfer is assumed to have occurred if either of the following conditions is met:

• Admission to an acute care institution or day surgery facility occurs less than 7 hours after discharge from another acute care institution or day surgery facility, regardless of whether the transfer is coded by either institution; or

• Admission to an acute care institution or day surgery facility occurs between 7 and 12 hours after discharge from another acute care institution or day surgery facility, and at least one of the institutions codes the transfer. All records with valid linkage keys, admission dates/times and discharge dates/times are linked across provinces. An acute care or day procedure record from a facility is linked to a subsequent acute care or day procedure record in any facility by matching the linkage keys.

# Identifying a particular cardiac intervention

Results are reported by cardiac care centre (place of service), regardless of whether the patient resides in the province providing a service or not. The exception is Quebec: non-residents of Quebec became identifiable starting in 2016–2017. Quebec results include non-Quebec residents as of 2016–2017.

A particular cardiac intervention within an episode of care is used to establish the denominator record and follow-up time period. For hospital-level attribution, the cardiac intervention (denominator case) will be assigned to 1 hospital per episode of care (see below for details). Numerator events will be attributed to the denominator case (i.e., the hospital performing the cardiac intervention).

The following selection criteria have been established to select the **particular cardiac intervention within an episode of care:**

- Only cardiac interventions performed in **cardiac care centres** and in one of the following scenarios are considered potential denominator cases:

  A) *Single cardiac intervention within an episode of care*

    – If there is only 1 cardiac intervention within the episode of care, it will be selected, and the intervention date will be the start of the follow-up.

  B) *Multiple cardiac interventions of the same type on 1 abstract (e.g., Hospital A reports 2 PCIs on different dates)*

    – Select the date of the **first** cardiac intervention as the start of the follow-up.

  C) *Multiple cardiac interventions of the same type on different abstracts (e.g., Hospital A and Hospital B both report PCIs on the same or different dates)*

    – For interventions that can happen in both acute care and day surgery settings (PCIs), select the intervention performed in day surgery, since it was likely done there as an out-of-hospital procedure; if more than one, select the one with the earlier intervention date as the start of the follow-up.

    – Otherwise, select the one with the earliest intervention date as the start of the follow-up.

**Note:** Scenario C applies to only a small proportion of cases, as most episodes of care do not have multiple cardiac interventions initiated at different facilities.

# Indicator calculation and presentation

When comparing outcomes across various centres, it is important to account for differences in patient characteristics that may vary among centres; without adjustment, data comparisons can be skewed by differences in patient populations. Risk adjustment is a method used to control for patient characteristics and other risk factors that may affect health care outcomes and improve comparability of results.

Statistical regression modelling, an indirect method of standardization, was used to perform risk adjustment. A logistic regression model is fitted with independent variables from the episode of care to ensure comparability across cardiac care centres (see Appendix 2 for the list of risk factors). The selected risk factors were identified based on a literature review, clinical evidence and expert group consultations using the principles of appropriateness, viability (i.e., sufficient number of events) and data availability. Risk factors reflecting comorbidities must be listed as significant pre-admit conditions on the patient's abstract for them to be identified for risk adjustment.

3 years of data (the most recent at the time of the release) were combined to create the Canadian average rate for risk adjustment.

Coefficients derived from the logistic regression model are used to calculate the probability of an outcome for each denominator case. The expected number of events for a centre is the sum of these probabilities. The risk-adjusted rate is calculated by dividing the observed number of events in each centre by the expected number of events and multiplying by the Canadian average rate.

The formula is as follows:

Risk-adjusted rate = (Observed cases ÷ Expected cases) × Canadian average rate

Where

**Observed cases =** the number of observed events (or numerator cases, such as actual number of deaths)

**Expected cases =** the number of expected events, adjusted for the distribution of risk factors in the hospitals; coefficients are derived from regression models to obtain the expected number of cases

In addition, 95% confidence interval (CI) limits for the risk-adjusted rates were calculated using the exact Poisson distribution to aid interpretation and comparisons.[1] CIs are used to establish whether the indicator result is statistically different from the average. The width of the CI illustrates the precision of the indicator's risk-adjusted rate. Indicator values are estimated to be accurate within the upper and lower CI 19 times out of 20 (95% CI). Risk-adjusted rates with CIs that do not contain the Canadian average rate can be considered statistically significantly different from the Canadian average rate.

It is important to note that a cardiac centre's expected level of performance in this indirect method of standardization is based on how all centres perform, because the number of expected cases is calculated based on regression models fitted on all cases from all cardiac centres. Furthermore, risk-adjustment modelling cannot entirely eliminate differences in patient characteristics among centres because not all pre-admission influences are adjusted for; if left unadjusted, centres that have the sickest patients or that treat rare or highly specialized groups of patients could still score poorly.

# Appendix 1: Core concomitant procedures (exclusions for cardiac surgery indicators) — CCI codes

| Description | CCI code |
|---|---|
| Excision partial, lobe of lung | 1.GR.87.^^ |
| Repair by decreasing size, lung not elsewhere classified | 1.GT.78.^^ |
| Repair, lung not elsewhere classified | 1.GT.80.^^ |
| Transplant, lung not elsewhere classified | 1.GT.85.^^ |
| Excision partial, lung not elsewhere classified | 1.GT.87.^^ |
| Destruction, cardiac conduction system | 1.HH.59.^^ |
| Therapeutic Interventions on the Atrium | 1.HM.^^.^^ |
| Division, interatrial septum | 1.HN.71.^^ |
| Repair, interatrial septum | 1.HN.80.^^ |
| Excision partial, interatrial septum no tissue used [e.g. excision alone] using open approach | 1.HN.87.LA |
| Implantation of internal device, ventricle | 1.HP.53.^^ |
| Removal of device, ventricle | 1.HP.55.^^ |
| Division, ventricle | 1.HP.71.^^ |
| Repair by decreasing size, ventricle | 1.HP.78.^^ |
| Repair, ventricle | 1.HP.80.^^ |
| Reattachment, ventricle | 1.HP.82.^^ |
| Transfer, ventricle | 1.HP.83.^^ |
| Excision partial, ventricle | 1.HP.87.^^ |
| Division, interventricular septum | 1.HR.71.^^ |
| Repair, interventricular septum | 1.HR.80.^^ |
| Construction or reconstruction, interventricular septum | 1.HR.84.^^ |
| Excision partial, interventricular septum | 1.HR.87.^^ |
| Compression, heart not elsewhere classified | 1.HZ.34.^^ |
| Implantation of internal device, heart not elsewhere classified open [thoracotomy] approach artificial heart | 1.HZ.53.LA-KP |
| Removal of foreign body, heart not elsewhere classified | 1.HZ.56.^^ |
| Extraction, heart not elsewhere classified | 1.HZ.57.^^ |
| Destruction, heart not elsewhere classified | 1.HZ.59.^^ |
| Incision NOS, heart not elsewhere classified | 1.HZ.70.^^ |
| Repair, heart not elsewhere classified | 1.HZ.80.^^ |
| Transplant, heart not elsewhere classified | 1.HZ.85.^^ |

| Description | CCI code |
|---|---|
| Excision partial, heart not elsewhere classified | 1.HZ.87.^^ |
| Repair by increasing size, aorta not elsewhere classified and location attribute = AS (Ascending aorta [root]) | 1.ID.79.^^ |
| Repair, aorta not elsewhere classified | 1.ID.80.^^ |
| Excision partial, aorta not elsewhere classified | 1.ID.87.^^ |
| Repair, aorta not elsewhere classified | 1.ID.80.^^ |
| Excision partial, aorta not elsewhere classified | 1.ID.87.^^ |
| Removal of device, coronary arteries | 1.IJ.55.^^ |
| Repair, coronary arteries | 1.IJ.80.^^ |
| Closure of fistula, coronary arteries | 1.IJ.86.^^ |
| Extraction, coronary veins | 1.IK.57.^^ |
| Repair, coronary veins | 1.IK.80.^^ |
| Excision partial, coronary veins | 1.IK.87.^^ |
| Occlusion, pulmonary artery | 1.IM.51.^^ |
| Extraction, pulmonary artery | 1.IM.57.^^ |
| Repair, pulmonary artery | 1.IM.80.^^ |
| Excision partial, pulmonary artery | 1.IM.87.^^ |
| Extraction, pulmonary vein | 1.IN.57.^^ |
| Repair, pulmonary vein | 1.IN.80.^^ |
| Excision partial, pulmonary vein | 1.IN.87.^^ |
| Dilation, carotid artery using percutaneous transluminal approach balloon dilator with (endovascular) stent (insertion) | 1.JE.50.GQ-OA |
| Extraction, carotid artery | 1.JE.57.^^ |
| Bypass, carotid artery | 1.JE.76.^^ |
| Repair, carotid artery | 1.JE.80.^^ |
| Excision partial, carotid artery | 1.JE.87.^^ |
| Excision partial, brachiocephalic arteries | 1.JJ.87.^^ |
| Repair, subclavian artery | 1.JK.80.^^ |
| Excision partial, subclavian artery | 1.JK.87.^^ |
| Repair, thoracic vessels not elsewhere classified | 1.JY.80.^^ |
| Excision partial, thoracic vessels not elsewhere classified | 1.JY.87.^^ |
| Repair, abdominal aorta | 1.KA.80.^^ |
| Excision partial, abdominal aorta | 1.KA.87.^^ |
| Repair, abdominal arteries not elsewhere classified | 1.KE.80.^^ |
| Therapeutic Interventions on the Interventricular Septum with Interatrial Septum and Heart Valves | 1.LC.^^.^^ |

# Appendix 2: Risk factor descriptions

| Risk factor | ICD-10-CA/CCI/other codes | Qualifier* |
|---|---|---|
| **Sex (male versus female)** | Not applicable | Not applicable |
| **Age (18–49, 50–69, 70–79, 80+)** | Not applicable | Reference group: 50–69 |
| **Urgent/emergent admission** | 3.IP.10.VX | Episodes that have a cardiac catheterization procedure (CCI code 3.IP.10.VX) within the previous 14 days of the index cardiac intervention and during an uninterrupted, continuous episode of care |
| **Coronary syndrome status** | Hierarchy of cases assigned as follows:<br><br>1) **STEMI:** I21.– Acute myocardial infarction (AMI), I22.– Subsequent myocardial infarction, I24.0 Coronary thrombosis not resulting in myocardial infarction AND R94.30 Electrocardiogram suggestive of ST segment elevation myocardial infarction [STEMI]<br><br>2) **NSTEMI/unspecified AMI:** I21.– Acute myocardial infarction, I22.– Subsequent myocardial infarction, I24.0 Coronary thrombosis not resulting in myocardial infarction AND R94.31 Abnormal cardiovascular function studies (biomarkers or ECG) suggestive of non ST segment elevation myocardial infarction [NSTEMI]<br><br>OR<br><br>I21.– or I22.– or I24.0, with no specification of STEMI/NSTEMI<br><br>3) **Unstable angina:** I20.0 Unstable angina<br><br>4) **Stable coronary artery disease (CAD):** I25.1– Atherosclerotic heart disease<br>OR<br><br>Cases that do not have any of the above assigned | Reference group: Stable CAD<br><br>Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)]<br><br>STEMI/NSTEMI:<br>Any diagnosis type |

| Risk factor | ICD-10-CA/CCI/other codes | Qualifier* |
|---|---|---|
| **Shock (for PCI indicators)** | R57.– Shock, not elsewhere classified | Diagnosis type (1) or [(M), (W), (X) or (Y) but not (2)]<br><br>OR<br><br>Diagnosis type (2) and diagnosis prefix = 5 (after admission and before the qualifying intervention) |
| **Shock (for cardiac surgery indicators)** | R57.– Shock, not elsewhere classified | Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)] |
| **Cerebrovascular disease** | I60.– Subarachnoid haemorrhage<br><br>I61.– Intracerebral haemorrhage<br><br>I62.– Other nontraumatic intracranial haemorrhage<br><br>I63.– Cerebral infarction<br><br>I64 Stroke, not specified as haemorrhage or infarction<br><br>I65.– Occlusion and stenosis of precerebral arteries, not resulting in cerebral infarction<br><br>I66.– Occlusion and stenosis of cerebral arteries, not resulting in cerebral infarction<br><br>I67.– Other cerebrovascular diseases<br><br>I69.– Sequelae of cerebrovascular disease<br><br>G45.0 Vertebro-basilar artery syndrome<br><br>G45.1 Carotid artery syndrome<br><br>G45.2 Multiple and bilateral precerebral artery syndromes<br><br>G45.4 Transient global amnesia<br><br>G45.8 Other transient cerebral ischaemic attacks and related syndromes<br><br>G45.9 Transient cerebral ischaemic attack, unspecified | Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)]<br><br>**Or**, for non-Quebec records only,<br><br>Diagnosis type [(M), (1), (2), (W), (X) or (Y)] on records outside of the episode of care within the previous 3 years of the episode of care where the intervention occurred |

| Risk factor | ICD-10-CA/CCI/other codes | Qualifier* |
|---|---|---|
| **Peripheral vascular disease** | I70.– Atherosclerosis<br><br>I71.3 Abdominal aortic aneurysm, ruptured<br><br>I71.4 Abdominal aortic aneurysm, without mention of rupture<br><br>I71.5 Thoracoabdominal aortic aneurysm, ruptured<br><br>I71.6 Thoracoabdominal aortic aneurysm, without mention of rupture<br><br>I72.1 Aneurysm and dissection artery of upper extremity<br><br>I72.2 Aneurysm and dissection renal artery<br><br>I72.3 Aneurysm and dissection iliac artery<br><br>I72.4 Aneurysm and dissection artery lower extremity<br><br>I73.– Other peripheral vascular diseases<br><br>K55.1 Chronic vascular disorders of intestine | Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)]<br><br>**Or**, for non-Quebec records only,<br><br>Diagnosis type [(M), (1), (2), (W), (X) or (Y)] on records outside of the episode of care within the previous 3 years of the episode of care where the intervention occurred |
| **Cardiac dysrhythmias** | I47.– Paroxysmal tachycardia<br><br>I48.– Atrial fibrillation and flutter<br><br>I49.– Other cardiac arrhythmias | Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)]<br><br>**Or**, for non-Quebec records only,<br><br>Diagnosis type (2) and diagnosis prefix = 5 (after admission and before the qualifying intervention) |
| **Endocarditis** | I01.1 Acute rheumatic endocarditis<br><br>I33.– Acute and subacute endocarditis<br><br>I38.– Endocarditis, valve unspecified<br><br>I39.8 Endocarditis, valve unspecified, in diseases classified elsewhere | Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)] |
| **Multiple cardiac interventions in same episode of care** | **For PCI cohort:**<br><br>CABG (1.IJ.76.^^)<br><br>OR<br><br>Valve surgery (1.HS.^^.^^, 1.HT.^^.^^, 1.HU.^^.^^, 1.HV.^^.^^, 1.HW.^^.^^)<br><br>**For isolated CABG cohort/combined CABG and AVR cohort:**<br>PCI (1.IJ.50.^^, 1.IJ.57.GT, 1.IJ.57.GU) | Not applicable |

| Risk factor | ICD-10-CA/CCI/other codes | Qualifier* |
|---|---|---|
| **Acute renal failure** | N17.– Acute renal failure | Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)] <br><br> **Or**, for non-Quebec records only, <br><br> Diagnosis type (2) and diagnosis prefix = 5 (after admission and before the qualifying intervention) |
| **Hypertension** | I10.– Essential (primary) hypertension <br><br> I11 Hypertensive heart disease <br><br> I12 Hypertensive renal disease <br><br> I13 Hypertensive heart and renal disease <br><br> I15.– Secondary hypertension | Diagnosis type (1), (C) or [(M), (W), (X) or (Y) but not (2)] |
| **Pneumonia** | J10.0 Influenza with pneumonia, seasonal influenza virus identified <br><br> J11.0 Influenza with pneumonia, virus not identified <br><br> J12.– Viral pneumonia, not elsewhere classified <br><br> J13 Pneumonia due to Streptococcus pneumoniae <br><br> J14 Pneumonia due to Haemophilus influenzae <br><br> J15.– Bacterial pneumonia, not elsewhere classified <br><br> J16.8 Pneumonia due to other specified infectious organisms <br><br> J18.– Pneumonia, organism unspecified <br><br> J85.1 Abscess of lung with pneumonia | Diagnosis type (1) or [(M), (W), (X) or (Y) but not (2)] |
| **Multivessel PCI** | 1.IJ.50.^^: <br> Extent attribute = DA, DC, DE, DF, UN <br><br> 1.IJ.57.GQ-^^, 1.IJ.57.GT, 1.IJ.57.GU: <br> Extent attribute = 2, 3, 4, 5, 6, D | Not applicable |
| **Previous cardiac surgery** | CABG (1.IJ.76.^^) <br><br> OR <br><br> Valve surgery (1.HS.^^.^^, 1.HT.^^.^^, 1.HU.^^.^^, 1.HV.^^.^^, 1.HW.^^.^^) | Within the previous 365 days of the episode of care where the intervention occurred |

| Risk factor | ICD-10-CA/CCI/other codes | Qualifier* |
|---|---|---|
| **Previous cardiac intervention (PCI, CABG, valve surgery)** | 1.IJ.50.^^, 1.IJ.57.GQ-^^, 1.IJ.57.GT, 1.IJ.57.GU, 1.IJ.76.^^, 1.HS.^^, 1.HT.^^, 1.HU.^^, 1.HV.^^, 1.HW.^^ | Within the previous 365 days of the episode of care where the intervention occurred |
| **Previous acute myocardial infarction (AMI)** | I21.– Acute myocardial infarction<br><br>I22.– Subsequent myocardial infarction | Diagnosis type [(M), (1), (C), (2), (W), (X) or (Y)] on records outside of the episode of care within the previous 365 days of the episode of care where the intervention occurred |
| **Transfer from acute care** | Not applicable | Patients who are transferred in from another acute, day surgery, ambulatory care or emergency institution to the index cardiac intervention institution |
| **Charlson Index score group†** | Not applicable | Not applicable |

**Notes**

*  Diagnosis typing applies to inpatient records only.

†  Charlson score group 1 = Charlson score 1–2; Charlson score group 2 = Charlson score 3 or higher (reference category is Charlson score group 0 = Charlson score 0). For further details on the Charlson Index, please refer to Appendix 3.

# Appendix 3: The Charlson Index

The Charlson Index is an overall comorbidity score. Evidence shows it to be highly associated with mortality, and it has been widely used in clinical research on mortality. Based on Quan's methodology,[2] using pre-admission comorbidities recorded on the abstract, the comorbid conditions below are used to calculate the Charlson Index score. Conditions within each group are counted only once (e.g., if I43 and I50 appear on the abstract, the score will be 2). If conditions from different groups are present on the abstract, their weights will be summed (e.g., if I50 and F01 are present on the abstract, the score will be 4).

| Comorbid conditions | ICD-10-CA codes[†] | Weight |
|---|---|---|
| Congestive heart failure | I099, I255, I420, I425, I426, I427, I428, I429, I43*, I50, P290 | 2 |
| Dementia | F01, F02*, F03, F051, G30, G311 | 2 |
| Chronic pulmonary disease | I278, I279, J40, J41, J42, J43, J44, J45, J47, J60, J61, J62, J63, J64, J65, J66, J67, J684, J701, J703 | 1 |
| Rheumatological diseases | M05, M06, M315, M32, M33, M34, M351, M353, M360* | 1 |
| Mild liver disease | B18, K700, K701, K702, K703, K709, K713, K714, K715, K717, K73, K74, K760, K762, K763, K764, K768, K769 | 2 |
| Diabetes with organ failure | E102, E103, E104, E105, E107, E112, E113, E114, E115, E117, E132, E133, E134, E135, E137, E142, E143, E144, E145, E147 | 1 |
| Hemiplegia or paraplegia | G041, G114, G801, G802, G81, G82, G830, G831, G832, G833, G834, G839 | 2 |
| Renal disease | N032, N033, N034, N035, N036, N037, N052, N053, N054, N055, N056, N057, N18, N19, N250, Z490, Z491, Z492 | 1 |
| Moderate or severe liver disease | I850, I859, I864, K704, K711, K721, K729, K765, K766, K767 | 4 |
| HIV infection | B24, O987 | 4 |
| Primary cancer | C0, C1, C20, C21, C22, C23, C24, C25, C26, C30, C31, C32, C33, C34, C37, C38, C39, C40, C41, C43, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C6, C70, C71, C72, C73, C74, C75, C76, C81, C82, C83, C84, C85, C88, C90, C91, C92, C93, C94, C95, C96, C97 | 2 |
| Metastatic cancer | C77, C78, C79, C80 | 6 |

**Notes**

† Diagnosis codes starting with the 3- or 4-digit codes are listed in the table.

For provinces other than Quebec, only diagnosis types (1) and [(M), (W), (X) and (Y) but not (2)] are used to calculate the Charlson Index score, with the following exceptions:

• Diagnosis type (3) is also used for all diabetes, cancer and metastatic carcinoma codes.

• Diagnosis type (3) is also used for asterisk (*) codes.

For Quebec, only diagnosis types (C) and [(M), (W), (X) and (Y) but not (2)] are used to calculate the Charlson Index score.

The distribution is as follows:

| Charlson group | Charlson scores in the groups |
|:---:|:---:|
| 0 | 0 |
| 1 | 1 and 2 |
| 2 | 3+ |

For the Cardiac Care quality indicators, a refined version of the Charlson Index is used. Specifically, F00, Z94.0, Z99.2 and I98.2 have been removed from the Charlson Index risk factor, as these codes are either asterisk codes and redundant since corresponding dagger codes are included, or they are optional to code. Scores from Quebec are re-grouped the same way as noted above.

# Appendix 4: Summary of CCI changes, version 2018, since May 2019

| Section/indicator | Disabled CCI codes | New CCI codes |
|---|---|---|
| **Risk factors** | 1.IJ.57.GQ-^^: Extraction, coronary arteries percutaneous transluminal approach | n/a |
| | n/a | 1.IJ.57.GT: Extraction, coronary arteries using percutaneous transluminal approach for atherectomy |
| | n/a | 1.IJ.57.GU: Extraction, coronary arteries using percutaneous transluminal approach for thrombectomy |
| **Core concomitant procedures** | 1.IA.^^.^^: Therapeutic Interventions on the Ascending Aorta: 1.IA.79.^^ 1.IA.80.^^ 1.IA.87.^^ | 1.ID.79.^^: Repair by increasing size, aorta not elsewhere classified and location attribute = AS (Ascending aorta [root]) |
| | 1.IB.^^.^^: Therapeutic Interventions on the Arch of Aorta: 1.IB.80.^^ 1.IB.87.^^ | 1.ID.80.^^: Repair, aorta not elsewhere classified |
| | 1.IC.^^.^^: Therapeutic Interventions on the Thoracic [descending] Aorta : 1.IC.80 1.IC.87 | 1.ID.87.^^: Excision partial, aorta not elsewhere classified |
| **30-Day In-Hospital Mortality After PCI,** | 1.IJ.57.GQ-^^: Extraction, coronary arteries percutaneous transluminal approach | n/a |
| **30-Day All-Cause Readmission Rate After PCI,** | n/a | 1.IJ.57.GT: Extraction, coronary arteries using percutaneous transluminal approach for atherectomy |
| **PCI Volume by Centre** | n/a | 1.IJ.57.GU: Extraction, coronary arteries using percutaneous transluminal approach for thrombectomy |
| **30-Day In-Hospital Mortality After Isolated AVR** | 1.HV.90.GP.^^: Excision total with reconstruction, aortic valve | 1.HV.90.GQ-XX-L: Excision total with reconstruction, aortic valve replacement of valve alone with xenograft tissue valve [e.g. bovine or porcine tissue] using percutaneous transluminal (transcatheter) arterial approach |
| **30-Day In-Hospital Mortality After CABG and AVR** | 1.HV.90.GP.^^: Excision total with reconstruction, aortic valve | 1.HV.90.GQ-XX-L: Excision total with reconstruction, aortic valve replacement of valve alone with xenograft tissue valve [e.g. bovine or porcine tissue] using percutaneous transluminal (transcatheter) arterial approach |

**Note**

n/a: Not applicable.

# References

1.  Daly L. Simple SAS macros for the calculation of exact binomial and Poisson confidence limits. *Computational Biology and Medicine*. 1992.

2.  Quan H, Li B, Couris CM, et al. Updating and validating the Charlson Comorbidity Index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *American Journal of Epidemiology*. 2011.

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