Measure Abbreviation: CARD 03

Data Collection Method: This measure is calculated based on data extracted from the electronic medical record combined with administrative data sources such as professional fee and discharge diagnoses data. This measure is explicitly not based on provider self-attestation.

Description: Percentage of high cardiac risk cases with significantly elevated postoperative troponin levels.

Measure Time Period: Anesthesia End to 72 hours after Anesthesia End

Measure Type: Outcome (Inverse measure)

Measure Summary: CARD 03 is an outcome measure that identifies high cardiac risk patients that have severely elevated troponin levels within 72 hours postoperatively.

Rationale: Preventing myocardial infarction is an important anesthetic goal. Protecting against this outcome is particularly relevant among patients with comorbid conditions or undergoing surgeries at high risk of major adverse cardiac events.

Troponin I levels are accurate markers of myocardial infarction. Postoperative myocardial injury within 72 hours (as defined by a Troponin I level >2x the 99th percentile upper reference limit) is associated with a significantly increased risk of 30-day mortality. Furthermore, any amount of postoperative myocardial injury (as defined by a Troponin I level > 0.03 ng/mL) is an independent predictor of 30-day mortality. Adjusted relative risk of death was 4.2 for patients with Troponin I ≥ 0.60 ng/mL.

Inclusions:
- All high-risk surgeries*
  OR
- All anesthetic cases performed on patients with history of ischemic heart disease, congestive heart failure, cerebrovascular disease, diabetes requiring preoperative insulin, or chronic kidney disease (baseline Cr > 2.0 mg/dL).**

* High-risk surgeries include intraperitoneal, intrathoracic, or suprainguinal vascular procedures, as adapted from the Revised Cardiac Risk Index (RCRI) and identified by Anesthesia CPT codes:

<table>
<thead>
<tr>
<th>High Risk Surgery Type</th>
<th>Anesthesia CPT Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraperitoneal</td>
<td>00730, 00754, 00756, 00790, 00792, 00794, 00796, 00797, 00840, 00844, 00846, 00848, 00851, 00866, 01140</td>
</tr>
<tr>
<td>Intrathoracic</td>
<td>00500, 00539, 00540, 00541, 00542, 00546, 00548, 00625, 00626, 01636,</td>
</tr>
<tr>
<td>Suprainguinal Vascular</td>
<td>00216, 00350, 00670, 00770, 00880, 00882, 01650, 01652, 01654, 01656, 01770, 01772, 01925, 01926</td>
</tr>
</tbody>
</table>

** Adjusted relative risk of death was 4.2 for patients with Troponin I ≥ 0.60 ng/mL.
** Comorbidities posing high cardiac risk are adapted from the Revised Cardiac Risk Index (RCRI) and are identified by Elixhauser Comorbidity Index variables (congestive heart failure, diabetes), preoperative lab values (baseline serum creatinine), or comorbidity-specific ICD-9/10 codes (ischemic heart disease, cerebrovascular disease):

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>Specific Diagnostic Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic Heart Disease</td>
<td>MPOG Phenotype – Coronary Artery Disease: <a href="https://collations.mpogresearch.org/Detail.aspx?name=Coronary%20Artery%20Disease">https://collations.mpogresearch.org/Detail.aspx?name=Coronary%20Artery%20Disease</a></td>
</tr>
<tr>
<td>Cerebrovascular Disease</td>
<td>MPOG Phenotype – Cerebrovascular Disease: <a href="https://collations.mpogresearch.org/Detail.aspx?name=Cerebrovascular%20Disease">https://collations.mpogresearch.org/Detail.aspx?name=Cerebrovascular%20Disease</a></td>
</tr>
<tr>
<td>Chronic Kidney Disease</td>
<td>Most recent serum creatinine within 60 days &gt; 2.0 mg/dL</td>
</tr>
</tbody>
</table>

**Exclusions:**

- ASA 5 and 6 cases.
- Outpatient cases
- Troponin I ≥ 0.01 ng/mL (or Troponin T ≥ 0.02 ng/mL) within 42 days prior to anesthesia start***
- Pacemaker insertions (CPT: 00530)
- Cardiac Ablation (CPT: 00537)
- Cardiac surgery without pump (CPT: 00560)
- Cardiac surgery with pump < 1 year old (CPT: 00561)
- Cardiac surgery with pump (CPT: 00562)
- Cardiac surgery with hypothermic arrest (CPT: 00563)
- CABG without pump (CPT: 00566)
- CABG with pump (CPT: 00567)
- Heart Transplant (CPT: 00580)
- Testing of cardioversion or defibrillator functions (CPT: 00534)
- Cardiac catheterization (CPT: 01920)
- Obstetric Non-Operative Procedures (CPT: 01958, 01960, 01967)
- Obstetric Non-Operative Procedures with procedure text: “Labor Epidural”

*** Rationale for excluding patient with troponin elevation within 42 days prior to date of surgery is based upon ACC/AHA guidelines recommending a delay in elective surgery for 6 weeks following myocardial infarction.

MPOG Concept IDs Required:

<table>
<thead>
<tr>
<th>Troponin MPOG Concept ID</th>
<th>Myocardial Injury MPOG Concept IDs</th>
<th>Creatinine MPOG Concept ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>5011  Formal lab – Cardiac Troponin I (cTnI ng/mL)</td>
<td>90201  CPOM measure Cardiac Arrest</td>
<td>5002   Formal lab – Creatinine, Serum/Plasma</td>
</tr>
<tr>
<td>3396  Formal lab – Cardiac Troponin I (cTnI ng/L)</td>
<td>90202  CPOM measure Myocardial Ischemia</td>
<td></td>
</tr>
<tr>
<td>3397  Formal lab – High-sensitivity Cardiac Troponin T (hs-cTnT ng/mL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3392  Formal lab – High-sensitivity Cardiac Troponin T (hs-cTnT ng/L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3401  Formal lab – High-sensitivity Cardiac Troponin T (hs-cTnT pg/mL)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data Diagnostics Affected:
- Percentage of Cases with Postoperative Troponin (Postoperative Troponin)
- Percentage of Cases with Professional Fee Procedure Codes (Pro Fee Procedures)
- Percentage of CPT Codes from Anesthesia Professional Fee Billing that are actually Anesthesia Codes (Anesthesia Codes)
- Percentage of Cases with a Meaningful Admission Type Mapping (Admission Type Mapping)
- Percentage of Cases with ASA Status (Cases with ASA Status)

Phenotypes Used:
- AdmissionType
- AnesthesiaCptsForMeasures
- AnesthesiaStart
- AnesthesiaEnd
- AsaStatusClassification
- BP01
- CerebrovascularDisease
- ComorbidityCongestiveHeartFailure
- ComorbidityDiabetesComplicated
- ComorbidityDiabetesUncomplicated
- CoronaryArteryDisease
- MpogPatientId
- PrimaryProvider

Other Measure Build Details:
- If another case starts within 72 hours, then the time window ends at anesthesia start of the subsequent case.

- For the preoperative Troponin I exclusion, cases with preoperative Troponin I values with ‘less than (<)’ included in the result will be included up to ‘<0.31.’ For example, preoperative Troponin I levels that are resulted as ‘<0.02’ will be included for the measure. However, a preoperative Troponin I value of 0.02 will be excluded. The rationale for this is each pathology department determines the lower bound for detecting Troponin I levels accurately. This is standardized to the health system but is not standard across all participating sites.

- For sites that use high sensitivity troponin T, although kinetics are different for Trop T and Trop I, cardiologists at The University of Michigan have shared that a hs-Trop T measurement of 30 pg/ml roughly correlates with the initial detectable level of Trop I (just above 0.1 ng/ml). An hs-Trop T of 140 pg/ml roughly correlates with a current Trop I value of 1.0 ng/ml. Using those endpoints in the slope intercept formula \( y = mx + b \), a Trop I value of .6 ng/ml roughly correlates to a hs-Trop T of .091 ng/ml

\[
y = .00818x + .1454
\]
\[
0.6 = 122.22(x) + .1454
\]
\[
x = 90.9 \text{ pg/mL or } .091 \text{ ng/mL}
\]

Success:
In cases with Troponin I or Troponin T value(s) available within 72 hours after anesthesia end, all values must be less than or equal to the following:
- Troponin I (ctnl) ≤ 600 ng/L
- Troponin I (ctnl) ≤ 0.6 ng/mL
- Troponin T (hs-cTnT) ≤ 91 ng/L
- Troponin T (hs-cTnT) ≤ 91 pg/mL
- Troponin T (hs-cTnT) ≤ 0.091 ng/mL
If no Troponin I (or Troponin T) values are available within 72 hours after anesthesia end and there is no documentation of perioperative myocardial injury (MPOG Concepts: 90201, 90202), the case will not be flagged (ie we presume no myocardial injury).

**Threshold:** ≤5%

**Responsible Provider:** Providers assigned to patient longest duration of case unless there are providers attributed for flagging BP 01 (sustained MAP < 55 mmHg) during case. In that case, BP 01 attribution takes precedence over longest duration.

**Method for determining Responsible Provider:**
1. Provider(s) who flagged BP 01. If not applicable, 
2. Provider(s) signed into the case for the longest duration.

**Risk Adjustment (for outcome measures):**

To evaluate provider-level risk adjustment we will calculate the observed to expected outcomes ratio (O/E). The O/E is calculated using a logistic regression model and predicts (given a set list of dependent patient and hospital level variables) the expected probability of having an elevated Troponin I level. We adjust for surgery risk score, emergent procedures, ASA, gender, age, body mass index, laboratory values, and teaching versus private hospital. Patient specific comorbidities are evaluated as well.

**References:**